DOCUMENTATION OF ENVIRONMENTAL INDICATOR DETERMINATION
Interim Final 2/5/99
RCRA Corrective Action
Environmental Indicator (EI) RCRIS code (CA725)
Current Human Exposures Under Control

Facility Name:	**Lyondell Chemical Company**
Facility Address:	**3801 West Chester Pike, Newtown Square, Pennsylvania 19073**
Facility EPA ID #:	**PAD046538211**

1. Has **all** available relevant/significant information on known and reasonably suspected releases to soil, groundwater, surface water/sediments, and air, subject to RCRA Corrective Action (e.g., from Solid Waste Management Units (SWMU), Regulated Units (RU), and Areas of Concern (AOC)), been **considered** in this EI determination?

[X] If yes – check here and continue with #2 below.

[ ] If no – re-evaluate existing data, or

[ ] If data are not available skip to #6 and enter "IN" (more information needed) status code.

BACKGROUND

Definition of Environmental Indicators (for the RCRA Corrective Action)

Environmental Indicators (EI) are measures being used by the RCRA Corrective Action program to go beyond programmatic activity measures (e.g., reports received and approved, etc.) to track changes in the quality of the environment. The two EI developed to-date indicate the quality of the environment in relation to current human exposures to contamination and the migration of contaminated groundwater. An EI for non-human (ecological) receptors is intended to be developed in the future.

Definition of "Current Human Exposures Under Control" EI

A positive "Current Human Exposures Under Control" EI determination ("YE" status code) indicates that there are no "unacceptable" human exposures to "contamination" (i.e., contaminants in concentrations in excess of appropriate risk-based levels) that can be reasonably expected under current land- and groundwater-use conditions (for all "contamination" subject to RCRA corrective action at or from the identified facility [i.e., site-wide]).

Relationship of EI to Final Remedies

While Final remedies remain the long-term objective of the RCRA Corrective Action program the EI are near-term objectives which are currently being used as Program measures for the Government Performance and Results Act of 1993, GPRA). The "Current Human Exposures Under Control" EI are for reasonably expected human exposures under current land- and groundwater-use conditions ONLY, and do not consider potential future land- or groundwater-use conditions or ecological receptors. The RCRA Corrective Action program's overall mission to protect human health and the environment requires that Final remedies address these issues (i.e., potential future human exposure scenarios, future land and groundwater uses, and ecological receptors).

Duration / Applicability of EI Determinations

EI Determinations status codes should remain in RCRIS national database ONLY as long as they remain true (i.e., RCRIS status codes must be changed when the regulatory authorities become aware of contrary information).

2. Are groundwater, soil, surface water, sediments, or air **media** known or reasonably suspected to be **"contaminated"**[1] above appropriately protective risk-based "levels" (applicable promulgated standards, as well as other appropriate standards, guidelines, guidance, or criteria) from releases subject to RCRA Corrective Action (from SWMUs, RUs or AOCs)?

	Yes	No	?	Rationale/Key Contaminants
Groundwater	X			No known releases due to facility operations. Exceedances of PADEP residential and non-residential groundwater MSCs for bis(2-ethylhexyl)phthalate and barium. SPL (presumably No. 2 fuel oil) was identified in MW-1 in 2010 (non-facility location).
Air (indoors)[2]		X		No known releases due to facility operations. Bis(2-ethylhexyl)phthalate is not a VI constituent of concern. SPL (presumably No. 2 fuel oil) identified in MW-1 adjacent to Training Center Building (non-facility location).
Surface Soil (e.g., <2 ft)		X		No known releases due to facility operations. No further action issued for UST excavation at Training Center in 1991; however, SPL (presumably No. 2 fuel oil) identified at MW-1(non-facility location).
Surface Water		X		No known releases due to facility operations. SPL (presumably No. 2 fuel oil) identified in MW-1; Extent of groundwater contamination unknown (non-facility location).
Sediment		X		No known releases due to facility operations. SPL (presumably No. 2 fuel oil) identified in MW-1; Extent of groundwater contamination unknown (non-facility location).
Subsurf. Soil (e.g., >2 ft)		X		No known releases due to facility operations. No further action issued for UST excavation at Training Center in 1991; however, SPL (presumably No. 2 fuel oil) recently identified at MW-1 (non-facility location).

[1] "Contamination" and "contaminated" describes media containing contaminants (in any form, NAPL and/or dissolved, vapors, or solids, that are subject to RCRA) in concentrations in excess of appropriately protective risk-based "levels" (for the media, that identify risks within the acceptable risk range).

[2] Recent evidence (from the Colorado Dept. of Public Health and Environment, and others) suggest that unacceptable indoor air concentrations are more common in structures above groundwater with volatile contaminants than previously believed. This is a rapidly developing field and reviewers are encouraged to look to the latest guidance for the appropriate methods and scale of demonstration necessary to be reasonably certain that indoor air (in structures located above (and adjacent to) groundwater with volatile contaminants) does not present unacceptable risks.

Air (outdoors)		X		Currently operating under a State Only Operating Permit with no known violations.

____ If no (for all media) - skip to #6, and enter "YE," status code after providing or citing appropriate "levels," and referencing sufficient supporting documentation demonstrating that these "levels" are not exceeded.

__X__ If yes (for any media) - continue after identifying key contaminants in each "contaminated" medium, citing appropriate "levels" (or provide an explanation for the determination that the medium could pose an unacceptable risk), and referencing supporting documentation.

____ If unknown (for any media) - skip to #6 and enter "IN" status code.

Rationale and Reference(s):
Lyondell Chemical Company (Lyondell or facility) is situated on 312 acres of land located at 3801 West Chester Pike, Newtown Square, Newtown Township, Delaware County, Pennsylvania. The property was ultimately subdivided into two separate parcels. The western 112 acres of the property (west of the main entry road) are currently owned and occupied by SAP America, Inc. (SAP). The eastern 200 acres of the property (east of the main entry road) are currently owned by BPG Real Estate Investors Straw Party 1 LP (BPG). Lyondell, along with multiple separate operating entities (e.g., Graham Partners, Catholic Health East and Medstaff, SAP, and the Ellis Athletic Center), currently lease building space from BPG. Note: Non-facility buildings in the complex included the Cottages, Gymnasium, Training Center, Auditorium, and Medical Building (also referred to as the Dispensary).

The facility is bordered to the north by vacant land and residences. Properties to the east, west, and south of the facility are primarily residential with some commercial properties intermixed. Bryn Mawr Hospital Health Center is located directly south of the facility on BPG's property. The remainder of the property owned by BPG has been approved for redevelopment, which will include office, retail, and residential uses. Currently, the property consists of approximately 20 percent impermeable surfaces (buildings and paved areas) and 80 percent permeable surfaces (vegetation and stormwater ponds).

The facility and surrounding properties are provided with potable water supplied by Aqua Pennsylvania, Inc.'s main system. There are no surface water intakes located within one mile of the facility, according to the PADEP eMapPA website (accessed February 1, 2010). According to the Department of Conservation and Natural Resources Pennsylvania Groundwater Information System, there are two water supply wells located within 0.5 miles of the facility. One well (reportedly a domestic supply well) is shown approximately 0.35 miles south of the facility at the current location of the CVS store located directly across West Chester Pike from the facility's main entry road. The second well (reportedly a public supply well for a skateboard park) is shown approximately 0.5 miles south of the facility in a residential area. Both wells are listed as 161 feet deep installed in November 1977. Based on the current land uses at the reported locations of the wells and because the township is serviced by the public water supply, it is not expected that these wells currently exist.

From 1921 through 1977, the property on which the facility is located was the campus of the Ellis School for Fatherless Girls. The property was purchased in October 1978 by Atlantic Richfield Company (ARCO) who subsequently constructed a facility complex on the eastern portion of the property from which its chemicals division operated under the name of ARCO Chemical Division of Atlantic Richfield Company. The facility was constructed in 1979 and began operating in 1981 as a research and development (R&D) center focusing on chemicals (primarily propylene oxide and its derivatives) that are used to make consumer end products. Research conducted at the facility ranged from small bench-scale experiments performed in its laboratories to pilot plants. No commercial chemical manufacturing was performed at this facility.

In October 1987, ARCO spun-off its chemicals division, transferring substantially all of the assets and liabilities of the ARCO Chemical Division of Atlantic Richfield Company. At this time, the facility began operating under the name of ARCO Chemical Company (ACC). ARCO retained ownership of the property and leased the facilities to ACC. In October 1997, ARCO (later bought by British Petroleum [BP]) sold the western half of the property (west of the main entry road) to SAP on which it constructed its headquarters building. The remaining eastern half of the property (east of the main entry road), including the ACC lease, was ultimately sold to SAP in March 2000. In July 1998, Lyondell Chemical Worldwide, Inc. acquired ACC, with ACC becoming a wholly-owned subsidiary of Lyondell Chemical Worldwide, Inc. and Lyondell assuming ACC's lease. In December 1999, Lyondell Chemical Worldwide, Inc. was merged into Lyondell Chemical Company. Lyondell Chemical Company continued to lease the facility from SAP.

In March 2000, Bayer Corporation (Bayer) purchased Lyondell's polyolefins business and continued to operate it from this location under its own USEPA generator identification number (PAR000023994), sub-leasing the space from Lyondell. Lyondell continued to operate the remainder its R&D facility at this time. In December 2002, Bayer vacated the property, retaining ownership of the polyols business. Bayer took some equipment with them when they vacated the property, then sold any of the equipment remaining at the facility back to Lyondell. (Note: Bayer does not own any of the equipment currently on-site, and did not own any of the property).

In June 2004, SAP sold approximately 200 acres of the 312-acre property, including the buildings leased by the facility and its lease, to BPG. SAP retained the remaining 112 acres where they constructed their current headquarters building. The 200 acre property (east of the main entry road) is currently owned by separate limited partnerships affiliated with BPG Properties Ltd. and managed by BPG Management Company L.P. The Lyondell-leased areas of the facility are operated by Lyondell Chemical Company, an indirect wholly-owned subsidiary of LyondellBasell Industries. N.V. (LyondellBasell). (Note: Lyondell merged with Basell Polyolefins in December 2007, but continued to operate under the name of Lyondell Chemical Company.) SAP currently owns the western 112 acres of the 312 acre property.

The facility currently serves as a R&D center for the company's chemicals and fuels businesses. It also served as the commercial office of its North American (N.A.) Polymers business from late 2009 through late 2010 when the N.A. Polymers business moved to its Houston location. R&D work (which is either conducted in the facility's laboratories, bays, high pressure cells, or pilot plants) focuses on improving the technology used to manufacture raw materials for consumer end products such as plastics, furniture foams, athletic footwear, paints, cosmetics, fabrics, gasoline and more. No commercial manufacturing takes place at this facility.

The facility is a large quantity generator of various types and quantities of chemical wastes. Wastes are stored in small containers (e.g., lab packs) and in 55-gallon drums until shipped off-site by licensed transporters for disposal at permitted facilities. In general, wastes generated at the facility have included acetone, isopropyl methanol, styrene, toluene, methylene chloride, acetone isopropanol, mixed amines, polyester resin, chloroform, methyl alcohol, allyl alcohol, toluene, diisocyanate, acetaldehyde, propylene oxide, propylene, isobutylene, n-butane, and petroleum hydrocarbons. Wastes are generated in the laboratories and bays located in the B-building and the pressure cells, and the E-building pilot plants. The wastes are stored in satellite accumulation areas until they are transferred to the main waste storage area located outside and north of the B-building. Wastes generated in the E-building pilot plants are temporarily stored in the separate smaller drum storage area (known as the E-Pad) located outside the northwest corner of the E-building, and are transferred daily to the main drum storage area. Two releases (one-liter container of acryloyl chloride and approximately six gallons of propylene oxide) were reported at the facility that were contained on concrete surfaces and immediately cleaned up.

Non-contact industrial cooling water and wastewater from the facility's laboratories and pilot plants are stored in two wastewater pretreatment aboveground storage tanks (ASTs) located behind (north of) the E-building. The wastewater pretreatment system consists of two open-top steel ASTs, one of 143,000 gallon capacity (interim tank) and one of 36,000 gallon capacity (overflow tank). The non-contact cooling water and laboratory wastewater is directed via underground drains to the 143,000 gallon AST which acts as a settling and equalization tank before the water is discharged daily under permit to the Delaware County Regional Water Quality Control Authority (DELCORA) Publicly Owned Treatment Works (POTW). The smaller AST (36,000 gallon AST) is available for overflow purposes. Facility representatives indicate the smaller holding tank is typically empty.

Multiple underground storage tanks (USTs) and ASTs were located on the 312 acre property. These included two 30,000-gallon USTs the heating and cooling plant; two 7,500-gallon USTs at the Training Center; one 1,000-gallon UST at the Dispensary; and one 550 gallon UST at the President's House. The USTs were used to store No. 2 fuel oil for heating purposes. These USTs (with the exception of the two 30,000-gallon USTs) were removed from the property by ACC in 1991. Extensive contamination was identified in the excavation for the two 7,500-gallon USTs located at the Training Center. Oil was observed flowing beneath the fill pipe of one of the USTs. The contaminated soil was excavated, and post-excavation soil samples analyzed for total petroleum hydrocarbons (TPH) showed the concentrations were below 100 parts per million (ppm). (Note: A TPH concentration of 377 ppm was detected in one of the post-excavation floor samples, and additional soil was reportedly removed in the vicinity of this sample. However, there was no documentation that confirmatory soil samples were collected from this area prior to backfilling the excavation.)

Post-excavation soil samples collected at the Dispensary UST excavation showed TPH concentrations were 11 ppm. However, initial post-excavation soil samples collected at the President's House UST excavation showed TPH concentrations of 911 ppm and 1,246 ppm. Accordingly, additional soil was removed and post-excavation soil samples showed TPH concentrations were below 100 ppm (27 and 39 ppm). PADEP determined that no further action was necessary for the four USTs. During this time, ACC also removed two 550-gallon ASTs that contained gasoline and diesel fuel in the area referred to as the Contractor's Area (currently the property owned and operated by SAP located west of the main entrance road). While removing the original ASTs, gasoline-impacted soil was observed, and approximately 120 yards of soil was excavated. No additional information (particularly related to confirmatory soil sampling) was provided in the report. Groundwater was not encountered during the investigation; therefore, no groundwater investigation was conducted at that time.

In November 1992, ACC removed seven additional USTs that contained the facility's raw and waste materials located behind (north of) the E-building. Four of the USTs were permanently closed. These included one 1,000-gallon light gasoline/oil tank (TK-103); one 6,500-gallon hexane tank (TK-104); one 6,500-gallon cyclopentane tank (TK-105); and one 6,500-gallon waste solvent/hexane tank (TK-107). The remaining three USTs were replaced with upgraded, compliant equipment. These included one 6,500-gallon styrene tank (TK-101), one 500-gallon pentane tank (TK-102), and one 2,500-gallon xylene/toluene tank (TK-106). The USTs appeared to be in good condition and no evidence of contamination was observed. All piping was aboveground. Three post-excavation soil samples were collected from beneath each UST. Samples were collected directly beneath and at three feet below the bottom of tanks T-101, T-102, and T-103; and at depths of one foot and four feet below the bottom of tanks T-104, T-105, T-106, and T-107. The samples were analyzed for volatile organic compounds (VOCs). The analytical results showed that VOCs were not detected in the soil samples. The excavation was backfilled with the excavated materials, which was reportedly pre-screened for contaminants. On March 8, 1993, PADEP issued a no further action determination for the seven USTs. Groundwater was not encountered during the investigation; therefore, no groundwater investigation was conducted at that time. The four USTs that remain are currently empty and are registered with PADEP.

In March 1998, while ACC was upgrading the equipment for the two 30,000-gallon fuel oil USTs adjacent to the boiler house, indications of a release were observed. Polynuclear aromatic hydrocarbons (PAHs) were identified in soil samples collected from the excavation area. However, none of the detected concentrations were above the PADEP direct contact residential and non-residential subsurface soil (2 to 15 feet) medium specific concentrations (MSCs) or the soil to groundwater, used aquifer, total dissolved solids (TDS) less than 2,500 milligrams per liter (mg/L) residential MSCs. Groundwater was not encountered during the investigation; therefore, no groundwater investigation was conducted at that time.

The current property owner (BPG) identified 15 groundwater monitoring wells on the property that were installed by previous property owners in 1997 (MW-104, MW-105, and MW-107) and 2000 (MW-1 through MW-11, and MW-4D). The wells range in depth from 28 to 60 feet below the ground surface (bgs). BPG determined that the wells were no longer necessary; however, prior to abandoning them, BPG contracted IES Engineers (IES) to collect one round of groundwater samples to determine the groundwater quality at the property. IES collected samples from 13 of the 15 wells in October 2010 and analyzed them for VOCs, semi-volatile organic compounds (SVOCs) and RCRA metals. One of the wells (MW-8) could not be located, and MW-1 could not be sampled because approximately 0.5 inches of separately phase liquid (SPL) was encountered in the well. (Note: MW-1 is located in the vicinity of the former 7,500-gallon fuel oil USTs removed at the Training Center in 1990.) The static water levels gauged in October 2010 ranged from 16.59 feet bgs on the northern portion of the property to 33.61 feet bgs at on the southern portion of the property. The interpreted direction of groundwater flow was to the south. EIS sampled 14 groundwater monitoring wells again in November and December 2011 to evaluate the groundwater quality at the property.

Groundwater: Several VOCs (chloroform, benzo(a)anthracene, bis(2-ethylhexyl)phthalate, dimethyl phthalate, and 2,6-dinitrotoluene) and dissolved metals (barium, cadmium, chromium, and silver) were detected in the 2010 groundwater samples. The concentrations were below the PADEP used aquifer, nonresidential MSCs except bis(2-ethylhexyl)phthalate and barium. Bis(2-ethylhexyl)phthalate was detected in one well (32 ug/L at MW-5) above the MSC of 6 ug/L, and barium was detected in two wells (2,500 ug/L at MW-4 and 2,600 ug/L at MW-4D) above the MSC of 2,000 ug/L. The source for these elevated concentrations was reportedly unknown; however, IES suspected that the elevated barium concentrations were naturally occurring conditions (IES, 2010). (Note: Bis(2-ethylhexyl)phthalate is used in the production of polyvinyl chloride [PVC] materials and is a common laboratory contaminant, which may contribute to the elevated concentration detected in the MW-5 sample. Monitoring well MW-5 is located upgradient of the facility's operational areas.) Groundwater sample results for wells surrounding the formerly and currently operational area of the facility indicate that groundwater has not been impacted by facility-related activities.

EIS sampled 14 groundwater monitoring wells again in November and December 2011 to evaluate the groundwater quality at the property. This time, MW-1 was sampled twice, in November and December 2011. Benzene (0.42 ug/L, 0.52 ug/L) was detected below the reporting limit, but greater than or equal to the method detection limit. The concentrations are below the used aquifer, residential and non-residential MSCs of 5 ug/L. No other monitoring wells samples detected benzene and only the MW-9 samples from both sampling events detected chloroform (2.4 ug/L and 1.1 ug/L) below the used aquifer, residential and non-residential MSCs of 80 ug/L.

The groundwater samples did detect SVOCs, most being detected in MW-1: acenaphthene, acenaphylene, bis(2-ethylhexyl)phthalate, 2-chlorophenol, di-n-butyl phthalate, fluorine, 2-methylnaphthalene, naphthalene, and phenanthrene; all SVOCs were below the respective used aquifer, residential and non-residential MSCs. Bis(2-ethylhexyl)phthalate and di-n-butyl phthalate were detected in the sample collected from MW-10, below the used aquifer, residential and non-residential MSCs. Only di-n-butyl phthalate was detected in MW-104, below the used aquifer, residential and non-residential MSCs.

Arsenic, barium, cadmium, chromium, lead, selenium, and silver were detected in one or more of the groundwater samples less than the respective used aquifer, residential and non-residential MSCs.

Air: The facility operates under a State Only Operating Permit (SMOP 23-00059) for its emissions sources. Emissions in excess of permit limits are not anticipated under normal operating scenarios. There are no known violations of the facility's air permits.

The vapor intrusion pathway was evaluated using the PADEP Land Recycling Program *Technical Guidance Manual – Section IV.A.4 (Vapor Intrusion into Buildings from Groundwater and Soil under the Act 2 Statewide Health Standard)* because it can be applied to both residential and nonresidential receptors. This guidance provides decision matrices for soil and groundwater (under a Statewide Health, generic approach) for determining if indoor air quality may be of concern.

Therefore, the PADEP Technical Guidance Manual was used, as deemed appropriate, to evaluate a potential vapor intrusion pathway for purposes of this human health exposure evaluation.

As previously discussed, ACC removed and/or upgraded seven USTs that contained both raw and waste materials from the area directly north of the E-building in 1992. No visual evidence of contamination was observed in the surrounding soils, which was confirmed by the results of post-excavation soil samples collected from beneath each of the USTs. PADEP issued a NFA determination for this area in March 1993. Several VOCs and SVOCs (chloroform, benzo(a)anthracene, bis(2-ethylhexyl)phthalate, dimethyl phthalate, and 2,6 dinitrotoluene) were detected in the 2010 groundwater samples. The concentrations were below the PADEP used aquifer, residential and non-residential MSCs except bis(2 ethylhexyl)phthalate, which was detected in one well (32 ug/L at MW-5) above the MSC of 6 ug/L. IES stated that the source for the bis(2-ethylhexyl)phthalate was unknown; however, MW-5 is located upgradient to the facility's operational areas. Therefore, it is not expected to be related to facility operations. In addition, bis(2-ethylhexyl)phthalate is not listed as a compound of concern in the PADEP guidance and is not a chemical of sufficient toxicity or volatility according to the USEPA vapor intrusion guidance. No other VOCs or SVOCs were detected in the groundwater samples above the PADEP residential and non-residential groundwater MSCs.

EIS sampled 14 groundwater monitoring wells again November and December 2011 to evaluate the groundwater quality at the property. This time, MW-1 was sampled twice, in November and December 2011. Benzene (0.42 ug/L, 0.52 ug/L) was detected below the reporting limit, but greater than or equal to the method detection limit. The concentrations are below the used aquifer, residential and non-residential MSCs of 5 ug/L. No other monitoring wells samples detected benzene and only the MW-9 samples from both sampling events detected chloroform (2.4 ug/L and 1.1 ug/L) below the used aquifer, residential and non-residential MSCs of 80 ug/L.

Benzene and chloroform are listed as chemicals of sufficient toxicity or volatility according to the USEPA vapor intrusion guidance. Chloroform was detected at a low concentration (2.4 micrograms per liter [ug/L]) in one well (MW-9) during one sampling event. Benzene concentrations in MW-1 are below the used aquifer, residential and non-residential MSCs of 5 ug/L. The detected concentrations are below corresponding "Target Groundwater Concentration Corresponding to Indoor Air Concentration." The Training Center Building is adjacent/west/sidegradient of MW-1. The closest downgradient buildings are more than 150 away from MW-1. (Note: The BPG representative indicated that the Training Center building is currently vacant and used only for storage at this time. This building is expected to be demolished in the future.) None of the buildings are believed to be inhabited. Therefore, it is concluded that the vapor intrusion pathway is not complete

__Soil:__ The soils underlying the property consist of clayey and sandy silt mixtures with various percentages of rock fragments to depths of 12 to 18 feet bgs. Highly weathered gneiss saprolite underlies the silt with a gradual transition to weathered gneiss bedrock. As previously discussed, approximately 20 percent of the 312 acre property is covered with impermeable surfaces. The remaining 80 percent is grass covered, which includes the areas where subsurface soil sampling was conducted in conjunction with UST removal activities. There have been no known releases to soil as a result of the facility's operations. The facility's waste handling and storage areas are within buildings, or situated on concrete surfaces with proper containment structures. In addition, post-excavation soil sampling conducted in conjunction with removal of the seven raw and waste materials USTs located north of the E-building that were used by the facility indicated that the soils beneath the USTs had not been impacted by the organic compounds once stored in them. Three of the USTs were replaced with upgraded systems; however, they remain empty.

Post-excavation soil sampling for the four fuel oil USTs located at the Training Center, Dispensary, and President's House buildings (non-facility location) indicated that where contaminated soil was encountered, it was removed to PADEP's satisfaction and the excavations were backfilled. During the October 2010 groundwater sampling event, it was documented that SPL was present in monitoring well MW-1 located near the Training Center (former location of two 7,500-gallon fuel oil USTs). The extent of the SPL in the subsurface soil has not been defined; therefore, the current chemical quality of the soil in this area is unknown.

Surface Water and Sediment: Two surface water bodies were identified within 0.5 miles of the operating area of the facility. Foxes Run is located approximately 0.4 miles east of the facility. Foxes Run flows eastward to its convergence with Darby Creek located approximately two miles east of the facility. Reeses Run is located approximately 0.15 miles northwest of the facility. Reeses Run flows southwesterly to its convergence with Crum Creek located approximately two miles southwest of the facility. Both surface water bodies are designated as cold water fisheries and are listed on the streams integrated list as attaining segments supporting aquatic life (eMapPA, 2011).

The headwaters for two other surface water bodies (Preston Run and Hunter Run) are located south of the facility across West Chester Pike. Both water bodies are tributaries to Crum Creek. Preston Run is a designated cold water fishery, while Hunter Run is designated as a warm water fishery. Both water bodies are listed on the streams integrated list as attaining segments supporting aquatic life (eMapPA, 2011).

There are three detention basins for retention of stormwater on the 312 acre property. Surface water runoff on the northern portion of the property flows to the north toward the northern most detention basin and Reeses Run. Surface water runoff on remainder of the property flows to the south and is intercepted by the detention basins located on the eastern and southern portions of the property. The facility formerly held an NPDES permit for discharges of stormwater to the detention basins that was superseded by a no exposure certification approved by PADEP in 2004. There have been no known discharges related to the facility operations to the detention basins. Based on this information, direct discharges of site-related chemicals to the nearby surface water bodies and sediment are not expected to be of concern at this time.

Collection of rainwater and spills that may occur in the drum storage containment pads are channeled by a sloped floor that discharges the water into a drain which is directed into either the main underground sump located centrally on the south edge of the main drum storage area or the self-contained underground sump located north of the E-building. Fluids contained in these sumps must be manually pumped and discharged either to the main stormwater drainage system or the facility's wastewater pretreatment ASTs.

Recent sampling of the onsite groundwater monitoring wells indicates that bis(2-ethylhexyl)phthalate and barium were present above the PADEP nonresidential MSCs in three of the wells. However, these two compounds were not detected at the nearest downgradient wells. In addition, it is believed that the presence of these compounds is not related to the operations formerly or currently conducted by the facility. Therefore, discharges of groundwater containing these two compounds to the surface water bodies south of the facility is not expected.

SPL indicative of No. 2 fuel oil was identified at MW-1 in October 2010; therefore, IES did not collect a groundwater sample from this well. EIS sampled MW-1 in November and December 2011. Benzene (0.42 ug/L, 0.52 ug/L) was detected below the reporting limit, but greater than or equal to the method detection limit. The concentrations are below the used aquifer, residential and non-residential MSCs of 5 ug/L. (Note: BPG plans further investigation of the groundwater contamination identified at the property, and has entered the property into the PADEP Act 2 Program.)

3. Are there **complete pathways** between "contamination" and human receptors such that exposures can be reasonably expected under the current (land- and groundwater-use) conditions?

Summary Exposure Pathway Evaluation Table

Potential **Human Receptors** (Under Current Conditions)

Contaminated Media	Residents	Workers	Day-Care	Construction	Trespassers	Recreation	Food[3]
Groundwater	No	No	No	No	No	No	No
~~Air (indoors)~~							
~~Soil (surface, e.g., <2 ft.~~							
~~Surface Water~~							
~~Sediment~~							
~~Soil (subsurface e.g., >2 ft.~~							
~~Air (outdoors)~~							

Instructions for Summary Exposure Pathway Evaluation Table:

1. Strike-out specific Media including Human Receptors' spaces for Media which are not "contaminated" as identified in #2 above.

2. enter "yes" or "no" for potential "completeness" under each "Contaminated" Media -- Human Receptor combination (Pathway).

Note: In order to focus the evaluation to the most probable combinations some potential "Contaminated" Media - Human Receptor combinations (Pathways) do not have check spaces ("___"). While these combinations may not be probable in most situations they may be possible in some settings and should be added as necessary.

__X__ If no (pathways are not complete for any contaminated media-receptor combination) - skip to #6, and enter "YE" status code, after explaining and/or referencing condition(s) in-place, whether natural or man-made, preventing a complete exposure pathway from each contaminated medium (e.g., use optional Pathway Evaluation Work Sheet to analyze major pathways).

___ If yes (pathways are complete for any "Contaminated" Media - Human Receptor combination) - continue after providing supporting explanation.

___ If unknown (for any "Contaminated" Media - Human Receptor combination) - skip to #6 and enter "IN" status code.

Rationale and Reference(s):
The static water levels in the on-site monitoring wells gauged in October 2010 ranged from 16.59 feet bgs on the northern portion of the property to 33.61 feet bgs on the southern portion of the property. Therefore, it is unlikely that direct contact with potentially contaminated groundwater would occur.

[3] Indirect Pathway/Receptor (e.g., vegetables, fruits, crops, meat and dairy products, fish, shellfish, etc.

The facility and surrounding area are supplied with public water, there are no known private or public water supply wells located within 0.5 miles of the facility, it is concluded that exposure to groundwater is not a potential exposure pathway for this facility.

4. Can the **exposures** from any of the complete pathways identified in #3 be reasonably expected to be **"significant"**[4] (i.e., potentially "unacceptable" because exposures can be reasonably expected to be: 1) greater in magnitude (intensity, frequency and/or duration) than assumed in the derivation of the acceptable "levels" (used to identify the "contamination"); or 2) the combination of exposure magnitude (perhaps even though low) and contaminant concentrations (which may be substantially above the acceptable "levels") could result in greater than acceptable risks)?

____ If no (exposures can not be reasonably expected to be significant (i.e., potentially "unacceptable") for any complete exposure pathway) - skip to #6 and enter "YE" status code after explaining and/or referencing documentation justifying why the exposures (from each of the complete pathways) to "contamination" (identified in #3) are not expected to be "significant."

____ If yes (exposures could be reasonably expected to be "significant" (i.e., potentially "unacceptable") for any complete exposure pathway) - continue after providing a description (of each potentially "unacceptable" exposure pathway) and explaining and/or referencing documentation justifying why the exposures (from each of the remaining complete pathways) to "contamination" (identified in #3) are not expected to be "significant."

____ If unknown (for any complete pathway) - skip to #6 and enter "IN" status code

Rationale and Reference(s):

5. Can the "significant" **exposures** (identified in #4) be shown to be within **acceptable** limits?

____ If yes (all "significant" exposures have been shown to be within acceptable limits) - continue and enter "YE" after summarizing <u>and</u> referencing documentation justifying why all "significant" exposures to "contamination" are within acceptable limits (e.g., a site-specific Human Health Risk Assessment).

____ If no (there are current exposures that can be reasonably expected to be "unacceptable")- continue and enter "NO" status code after providing a description of each potentially "unacceptable" exposure.

____ If unknown (for any potentially "unacceptable" exposure) - continue and enter "IN" status code

Rationale and Reference(s):

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[4] If there is any question on whether the identified exposures are "significant" (i.e., potentially "unacceptable") consult a human health Risk Assessment specialist with appropriate education, training and experience.

6. Check the appropriate RCRIS status codes for the Current Human Exposures Under Control EI event code (CA725), and obtain Supervisor (or appropriate Manager) signature and date on the EI determination below (and attach appropriate supporting documentation as well as a map of the facility):

X YE - Yes, "Current Human Exposures Under Control" has been verified. Based on a review of the Information contained in this EI Determination, "Current Human Exposures" are expected to be "Under Control" at the **Lyondell Chemical Company** facility, EPA ID # **PAD046538211** located at **3801 West Chester Pike, Newtown Square, Pennsylvania 19073** under current and reasonably expected conditions. This determination will be re-evaluated when the Agency/State becomes aware of significant changes at the facility.

____ NO - "Current Human Exposures" are NOT "Under Control."

____ IN - More information is needed to make a determination.

Completed by (signature) ________________ Date ________

(print) ________________

(title) ________________

Supervisor (signature) ________________ Date ________

(print) ________________

(title) ________________

(EPA Region or State) ________________

Locations where References may be found:

USEPA Region III
Waste and Chemical Mgmt. Division
1650 Arch Street
Philadelphia, PA 19103

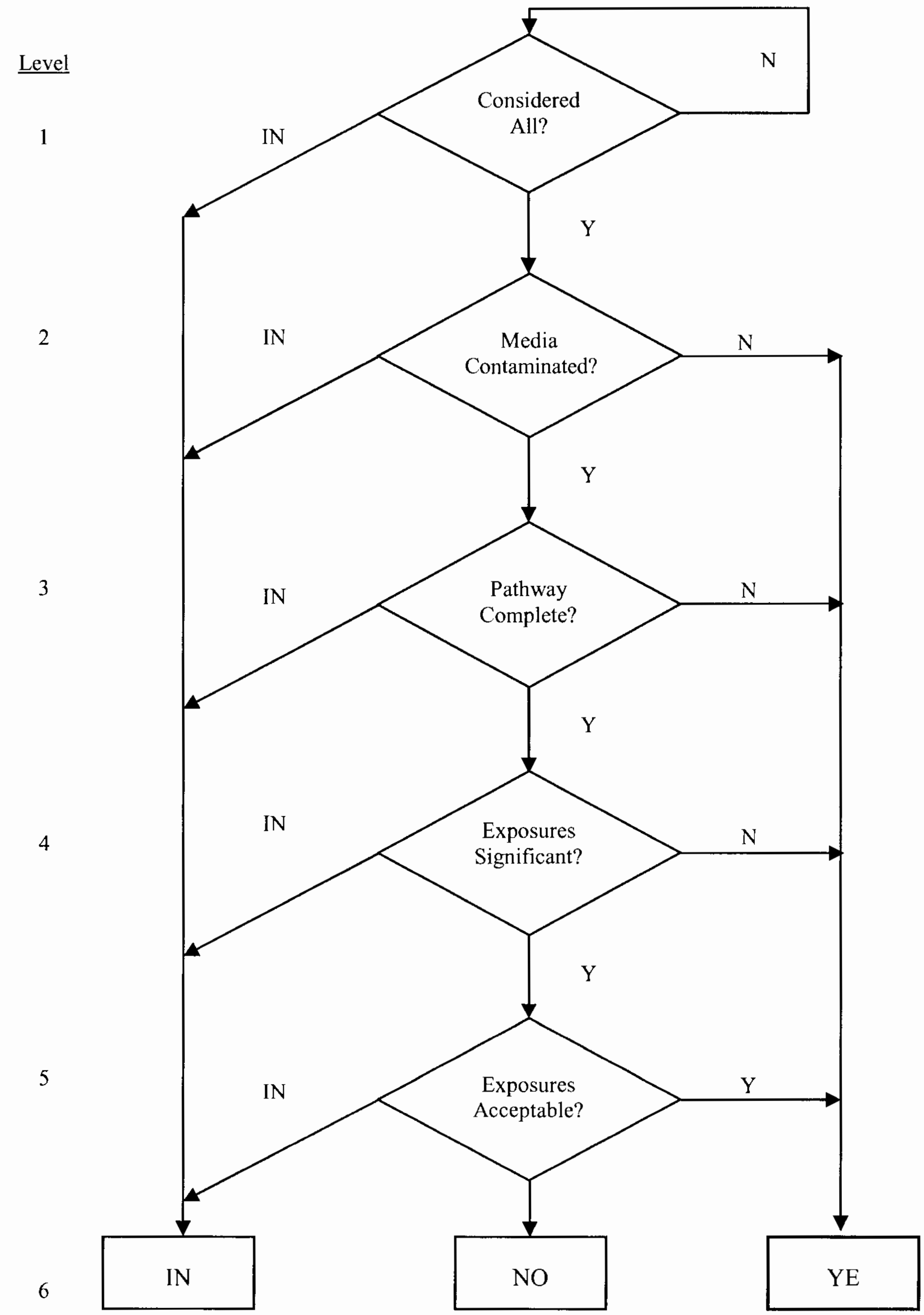
PADEP
South East Regional Office
2 East Main Street
Norristown, PA 19401

Contact telephone and e-mail numbers
(signature) ________________
(print) ________________
(title) ________________

FINAL NOTE: THE HUMAN EXPOSURES EI IS A QUALITATIVE SCREENING OF EXPOSURES AND THE DETERMINATIONS WITHIN THIS DOCUMENT SHOULD NOT BE USED AS THE SOLE BASIS FOR RESTRICTING THE SCOPE OF MORE DETAILED (E.G., SITE-SPECIFIC) ASSESSMENTS OF RISK.

Facility Name: Lyondell Chemical Company
EPA ID# PAD046538211
City/State Newtown Square, PA 19073

CURRENT HUMAN EXPOSURES UNDER CONTROL (CA725)



DOCUMENTATION OF ENVIRONMENTAL INDICATOR DETERMINATION
Interim Final 2/5/99
RCRA Corrective Action
Environmental Indicator (EI) RCRIS code (CA750)

Migration of Contaminated Groundwater Under Control

Facility Name: **Lyondell Chemical Company**
Facility Address: **3801 West Chester Pike, Newtown Square, Pennsylvania 19073**
Facility EPA ID #: **PAD046538211**

1. Has all available relevant/significant information on known and reasonably suspected releases to the groundwater media, subject to RCRA Corrective Action (e.g., from Solid Waste Management Units [SWMU], Regulated Units [RU], and Areas of Concern [AOC])

   - [X] If yes – check here and continue with #2 below.
   - [ ] If no – re-evaluate existing data, or
   - [ ] If data are not available skip to #6 and enter "IN" (more information needed) status code.

BACKGROUND

Definition of Environmental Indicators (for the RCRA Corrective Action)

Environmental Indicators (EI) are measures being used by the RCRA Corrective Action program to go beyond programmatic activity measures (e.g., reports received and approved, etc.) to track changes in the quality of the environment. The two EI developed to-date indicate the quality of the environment in relation to current human exposures to contamination and the migration of contaminated groundwater. An EI for non-human (ecological) receptors is intended to be developed in the future.

Definition of "Migration of Contaminated Groundwater Under Control" EI

A positive "Migration of Contaminated Groundwater Under Control" EI determination ("YE" status code) indicates that the migration of "contaminated" groundwater has stabilized, and that monitoring will be conducted to confirm that contaminated groundwater remains within the original "area of contaminated groundwater" (for all groundwater "contamination" subject to RCRA corrective action at or from the identified facility (i.e., site-wide)).

Relationship of EI to Final Remedies

While Final remedies remain the long-term objective of the RCRA Corrective Action program the EI are near-term objectives which are currently being used as Program measures for the Government Performance and Results Act of 1993, GPRA). The "Migration of Contaminated Groundwater Under Control" EI pertains ONLY to the physical migration (i.e., further spread) of contaminated ground water and contaminants within groundwater (e.g., non-aqueous phase liquids or NAPLs). Achieving this EI does not substitute for achieving other stabilization or final remedy requirements and expectations associated with sources of contamination and the need to restore, wherever practicable, contaminated groundwater to be suitable for its designated current and future uses.

Duration / Applicability of EI Determinations

EI Determinations status codes should remain in RCRIS national database ONLY as long as they remain true (i.e., RCRIS status codes must be changed when the regulatory authorities become aware of contrary information).

2. Is **groundwater** known or reasonably suspected to be **"contaminated"**[1] above appropriately protective "levels" (i.e., applicable promulgated standards, as well as other appropriate standards, guidelines, guidance, or criteria) from releases subject to RCRA Corrective Action, anywhere at, or from, the facility?

__X__ If yes - continue after identifying key contaminants, citing appropriate "levels," and referencing supporting documentation.

____ If no - skip to #8 and enter "YE" status code, after citing appropriate "levels," and referencing supporting documentation to demonstrate that groundwater is not "contaminated."

____ If unknown - skip to #8 and enter "IN" status code.

Rationale and Reference(s):
Lyondell Chemical Company (Lyondell or facility) is situated on 312 acres of land located at 3801 West Chester Pike, Newtown Square, Newtown Township, Delaware County, Pennsylvania. The property was ultimately subdivided into two separate parcels. The western 112 acres of the property (west of the main entry road) are currently owned and occupied by SAP America, Inc. (SAP). The eastern 200 acres of the property (east of the main entry road) are currently owned by BPG Real Estate Investors Straw Party 1 LP (BPG). Lyondell, along with multiple separate operating entities (e.g., Graham Partners, Catholic Health East and Medstaff, SAP, and the Ellis Athletic Center), currently lease building space from BPG. Note: Non-facility buildings in the complex included the Cottages, Gymnasium, Training Center, Auditorium, and Medical Building (also referred to as the Dispensary).

The facility is bordered to the north by vacant land and residences. Properties to the east, west, and south of the facility are primarily residential with some commercial properties intermixed. Bryn Mawr Hospital Health Center is located directly south of the facility on BPG's property. The remainder of the property owned by BPG has been approved for redevelopment, which will include office, retail, and residential uses. Currently, the property consists of approximately 20 percent impermeable surfaces (buildings and paved areas) and 80 percent permeable surfaces (vegetation and stormwater ponds).

The facility and surrounding properties are provided with potable water supplied by Aqua Pennsylvania, Inc.'s main system. There are no surface water intakes located within one mile of the facility, according to the PADEP eMapPA website (accessed February 1, 2010). According to the Department of Conservation and Natural Resources Pennsylvania Groundwater Information System, there are two water supply wells located within 0.5 miles of the facility. One well (reportedly a domestic supply well) is shown approximately 0.35 miles south of the facility at the current location of the CVS store located directly across West Chester Pike from the facility's main entry road. The second well (reportedly a public supply well for a skateboard park) is shown approximately 0.5 miles south of the facility in a residential area. Both wells are listed as 161 feet deep installed in November 1977. Based on the current land uses at the reported locations of the wells and because the township is serviced by the public water supply, it is not expected that these wells currently exist.

From 1921 through 1977, the property on which the facility is located was the campus of the Ellis School for Fatherless Girls. The property was purchased in October 1978 by Atlantic Richfield Company (ARCO) who subsequently constructed a facility complex on the eastern portion of the property from which its chemicals division operated under the name of ARCO Chemical Division of Atlantic Richfield Company. The facility was constructed in 1979 and began operating in 1981 as a research and development (R&D) center focusing on chemicals (primarily propylene oxide and its derivatives) that are used to make consumer end products. Research conducted at the facility ranged from small bench-scale experiments performed in its laboratories to pilot plants. No commercial chemical manufacturing was performed at this facility.

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[1] "Contamination" and "contaminated" describes media containing contaminants (in any form, NAPL and/or dissolved, vapors, or solids, that are subject to RCRA) in concentrations in excess of appropriate "levels" (appropriate for the protection of the groundwater resource and its beneficial uses).

In October 1987, ARCO spun-off its chemicals division, transferring substantially all of the assets and liabilities of the ARCO Chemical Division of Atlantic Richfield Company. At this time, the facility began operating under the name of ARCO Chemical Company (ACC). ARCO retained ownership of the property and leased the facilities to ACC. In October 1997, ARCO (later bought by British Petroleum [BP]) sold the western half of the property (west of the main entry road) to SAP on which it constructed its headquarters building. The remaining eastern half of the property (east of the main entry road), including the ACC lease, was ultimately sold to SAP in March 2000. In July 1998, Lyondell Chemical Worldwide, Inc. acquired ACC, with ACC becoming a wholly-owned subsidiary of Lyondell Chemical Worldwide, Inc. and Lyondell assuming ACC's lease. In December 1999, Lyondell Chemical Worldwide, Inc. was merged into Lyondell Chemical Company. Lyondell Chemical Company continued to lease the facility from SAP.

In March 2000, Bayer Corporation (Bayer) purchased Lyondell's polyolefins business and continued to operate it from this location under its own USEPA generator identification number (PAR000023994), sub-leasing the space from Lyondell. Lyondell continued to operate the remainder its R&D facility at this time. In December 2002, Bayer vacated the property, retaining ownership of the polyols business. Bayer took some equipment with them when they vacated the property, then sold any of the equipment remaining at the facility back to Lyondell. (Note: Bayer does not own any of the equipment currently on-site, and did not own any of the property).

In June 2004, SAP sold approximately 200 acres of the 312-acre property, including the buildings leased by the facility and its lease, to BPG. SAP retained the remaining 112 acres where they constructed their current headquarters building. The 200 acre property (east of the main entry road) is currently owned by separate limited partnerships affiliated with BPG Properties Ltd. and managed by BPG Management Company L.P. The Lyondell-leased areas of the facility are operated by Lyondell Chemical Company, an indirect wholly-owned subsidiary of LyondellBasell Industries. N.V. (LyondellBasell). (Note: Lyondell merged with Basell Polyolefins in December 2007, but continued to operate under the name of Lyondell Chemical Company.) SAP currently owns the western 112 acres of the 312 acre property.

The facility currently serves as a R&D center for the company's chemicals and fuels businesses. It also served as the commercial office of its North American (N.A.) Polymers business from late 2009 through late 2010 when the N.A. Polymers business moved to its Houston location. R&D work (which is either conducted in the facility's laboratories, bays, high pressure cells, or pilot plants) focuses on improving the technology used to manufacture raw materials for consumer end products such as plastics, furniture foams, athletic footwear, paints, cosmetics, fabrics, gasoline and more. No commercial manufacturing takes place at this facility.

The facility is a large quantity generator of various types and quantities of chemical wastes. Wastes are stored in small containers (e.g., lab packs) and in 55-gallon drums until shipped off-site by licensed transporters for disposal at permitted facilities. In general, wastes generated at the facility have included acetone, isopropyl methanol, styrene, toluene, methylene chloride, acetone isopropanol, mixed amines, polyester resin, chloroform, methyl alcohol, allyl alcohol, toluene, diisocyanate, acetaldehyde, propylene oxide, propylene, isobutylene, n-butane, and petroleum hydrocarbons. Wastes are generated in the laboratories and bays located in the B-building and the pressure cells, and the E-building pilot plants. The wastes are stored in satellite accumulation areas until they are transferred to the main waste storage area located outside and north of the B-building. Wastes generated in the E-building pilot plants are temporarily stored in the separate smaller drum storage area (known as the E-pad) located outside the northwest corner of the E-building, and are transferred daily to the main drum storage area. Two releases (one-liter container of acryloyl chloride and approximately six gallons of propylene oxide) were reported at the facility that were contained on concrete surfaces and immediately cleaned up.

Non-contact industrial cooling water and wastewater from the facility's laboratories and pilot plants are stored in two wastewater pretreatment aboveground storage tanks (ASTs) located behind (north of) the E-building. The wastewater pretreatment system consists of two open-top steel ASTs, one of 143,000-gallon capacity (interim tank) and one of 36,000-gallon capacity (overflow tank). The non-contact cooling water and laboratory wastewater is directed via underground drains to the 143,000-gallon AST which acts as a settling and equalization tank before the water is discharged daily under permit to the Delaware County Regional Water Quality Control Authority (DELCORA) Publicly Owned Treatment Works (POTW). The smaller AST (36,000-gallon AST) is available for overflow purposes. Facility representatives indicate the smaller holding tank is typically empty.

Multiple underground storage tanks (USTs) and ASTs were located on the 312 acre property. These included two 30,000-gallon USTs the heating and cooling plant; two 7,500-gallon USTs at the Training Center; one 1,000-gallon UST at the Dispensary; and one 550-gallon UST at the President's House. The USTs were used to store No. 2 fuel oil for heating purposes. These USTs (with the exception of the two 30,000-gallon USTs) were removed from the property by ACC in 1991. Extensive contamination was identified in the excavation for the two 7,500-gallon USTs located at the Training Center. Oil was observed flowing beneath the fill pipe of one of the USTs. The contaminated soil was excavated, and post-excavation soil samples analyzed for total petroleum hydrocarbons (TPH) showed the concentrations were below 100 parts per million (ppm). (Note: A TPH concentration of 377 ppm was detected in one of the post-excavation floor samples, and additional soil was reportedly removed in the vicinity of this sample. However, there was no documentation that confirmatory soil samples were collected from this area prior to backfilling the excavation.)

Post-excavation soil samples collected at the Dispensary UST excavation showed TPH concentrations were 11 ppm. However, initial post-excavation soil samples collected at the President's House UST excavation showed TPH concentrations of 911 ppm and 1,246 ppm. Accordingly, additional soil was removed and post-excavation soil samples showed TPH concentrations were below 100 ppm (27 ppm and 39 ppm). PADEP determined that no further action was necessary for the four USTs. During this time, ACC also removed two 550-gallon ASTs that contained gasoline and diesel fuel in the area referred to as the Contractor's Area (currently the property owned and operated by SAP located west of the main entrance road). While removing the original ASTs, gasoline-impacted soil was observed, and approximately 120 yards of soil was excavated. No additional information (particularly related to confirmatory soil sampling) was provided in the report. Groundwater was not encountered during the investigation; therefore, no groundwater investigation was conducted at that time.

In November 1992, ACC removed seven additional USTs that contained the facility's raw and waste materials located behind (north of) the E-building. Four of the USTs were permanently closed. These included one 1,000-gallon light gasoline/oil tank (TK-103); one 6,500-gallon hexane tank (TK-104); one 6,500-gallon cyclopentane tank (TK-105); and one 6,500-gallon waste solvent/hexane tank (TK-107). The remaining three USTs were replaced with upgraded, compliant equipment. These included one 6,500-gallon styrene tank (TK-101), one 500-gallon pentane tank (TK-102), and one 2,500-gallon xylene/toluene tank (TK-106). The USTs appeared to be in good condition and no evidence of contamination was observed. All piping was aboveground. Three post-excavation soil samples were collected from beneath each UST. Samples were collected directly beneath and at three feet below the bottom of tanks T-101, T-102, and T-103; and at depths of one foot and four feet below the bottom of tanks T-104, T-105, T-106, and T-107. The samples were analyzed for volatile organic compounds (VOCs). The analytical results showed that VOCs were not detected in the soil samples. The excavation was backfilled with the excavated materials, which was reportedly pre-screened for contaminants. On March 8, 1993, PADEP issued a no further action determination for the seven USTs. Groundwater was not encountered during the investigation; therefore, no groundwater investigation was conducted at that time. The four USTs that remain are currently empty and are registered with PADEP.

In March 1998, while ACC was upgrading the equipment for the two 30,000-gallon fuel oil USTs adjacent to the boiler house, indications of a release were observed. Polynuclear aromatic hydrocarbons (PAHs) were identified in soil samples collected from the excavation area. However, none of the detected concentrations were above the PADEP direct contact residential and non-residential subsurface soil (2 to 15 feet) medium-specific concentrations (MSCs) or the soil to groundwater, used aquifer, total dissolved solids (TDS) less than 2,500 milligrams per liter (mg/L) residential MSCs. Groundwater was not encountered during the investigation; therefore, no groundwater investigation was conducted at that time.

The current property owner (BPG) identified 15 groundwater monitoring wells on the property that were installed by previous property owners in 1997 (MW-104, MW-105, and MW-107) and 2000 (MW-1 through MW-11, and MW-4D). The wells range in depth from 28 to 60 feet bgs. BPG determined that the wells were no longer necessary; however, prior to abandoning them, BPG contracted IES Engineers (IES) to collect one round of groundwater samples to determine the groundwater quality at the property. IES collected samples from 13 of the 15 wells in October 2010. One of the wells (MW-8) could not be located, and MW-1 could not be sampled because approximately 0.5 inches of separately phase liquid (SPL) was encountered in the well. (Note: MW-1 is located in the vicinity of the former 7,500-gallon fuel oil USTs removed at the Training Center in 1990.) The static water levels gauged in October 2010 ranged from 16.59 feet bgs on the northern portion of the property to 33.61 feet bgs at on the southern portion of the property. The interpreted direction of groundwater flow was to the south.

Several VOCs and SVOCs (chloroform, benzo(a)anthracene, bis(2-ethylhexyl)phthalate, dimethyl phthalate, and 2,6-dinitrotoluene) and dissolved metals (barium, cadmium, chromium, and silver) were detected in the 2010 groundwater samples. The concentrations were below the PADEP used aquifer, residential and non-residential MSCs except bis(2-ethylhexyl)phthalate and barium. Bis(2-ethylhexyl)phthalate was detected in one well (32 ug/L at MW-5) above the MSC of 6 ug/L, and barium was detected in two wells (2,500 ug/L at MW-4 and 2,600 ug/L at MW-4D) above the MSC of 2,000 ug/L. The source for these elevated concentrations was reportedly unknown; however, IES suspected that the elevated barium concentrations were naturally occurring conditions (IES, 2010). (Note: Bis(2-ethylhexyl)phthalate is used in the production of polyvinyl chloride [PVC] materials and is a common laboratory contaminant, which may contribute to the elevated concentration detected in the MW-5 sample. Monitoring well MW-5 is located upgradient to the facility's operational areas.) Groundwater sample results for wells surrounding the formerly and currently operational area of the facility indicate that groundwater has not been impacted by facility-related activities.

EIS sampled 14 groundwater monitoring wells again November and December 2011 to evaluate the groundwater quality at the property. This time, MW-1 was sampled twice, in November and December 2011. Benzene (0.42 ug/L, 0.52 ug/L) was detected below the reporting limit, but greater than or equal to the method detection limit. The concentrations are below the used aquifer, residential and non-residential MSCs of 5 ug/L. No other monitoring wells samples detected benzene and only the MW-9 samples from both sampling events detected chloroform (2.4 ug/L and 1.1 ug/L) below the used aquifer, residential and non-residential MSCs of 80 ug/L.

The groundwater samples did detect SVOCs, most being detected in MW-1: acenaphthene, acenaphylene, bis(2-ethylhexyl)phthalate, 2-chlorophenol, di-n-butyl phthalate, fluorine, 2-methylnaphthalene, naphthalene, and phenanthrene; all SVOCs were below the respective used aquifer, residential and non-residential MSCs. Bis(2-ethylhexyl)phthalate and di-n-butyl phthalate were detected in the sample collected from MW-10, below the used aquifer, residential and non-residential MSCs. Only di-n-butyl phthalate was detected in MW-104, below the used aquifer, residential and non-residential MSCs.

Arsenic, barium, cadmium, chromium, lead, selenium, and silver were detected in one or more of the groundwater samples less than the respective used aquifer, residential and non-residential MSCs.

In January 2011, BPG submitted a NIR to PADEP, which stated that BPG intends to demonstrate attainment of the SHS for groundwater under the PADEP Voluntary Cleanup (Act 2) Program. This will include additional groundwater characterization, soil sampling in the vicinity of the two former 7,500-gallon fuel oil USTs at the Training Center, and analyzing the samples for the individual constituents of No. 2 fuel oil. In addition, the fuel oil USTs were installed by the school prior to ARCO's purchase of the property. Ownership of the areas where the fuel oil USTs were removed was transferred to the subsequent property owners [SAP, and later BPG].

3. Has the **migration** of contaminated groundwater **stabilized** (such that contaminated groundwater is expected to remain within "existing area of contaminated groundwater"[2] as defined by the monitoring locations designated at the time of this determination)?

__X__ If yes - continue, after presenting or referencing the physical evidence (e.g., groundwater sampling/measurement/migration barrier data) and rationale why contaminated groundwater is expected to remain within the (horizontal or vertical) dimensions of the "existing area of groundwater contamination"[2]).

____ If no (contaminated groundwater is observed or expected to migrate beyond the designated locations defining the "existing area of groundwater contamination"[2]) - skip to #8 and enter "NO" status code, after providing an explanation.

____ If unknown - skip to #8 and enter "IN" status code.

Rationale and Reference(s):
The detected VOCs, SVOCs and metals concentrations were below the PADEP used aquifer, residential and non-residential MSCs except bis(2-ethylhexyl)phthalate and barium. Bis(2-ethylhexyl)phthalate was detected in one well (32 ug/L at MW-5) above the MSC of 6 ug/L, and barium was detected in two wells (2,500 ug/L at MW-4 and 2,600 ug/L at MW-4D) above the MSC of 2,000 ug/L. The source for these elevated concentrations was reportedly unknown; however, IES suspected that the elevated barium concentrations were naturally occurring conditions (IES, 2010). (Note: Bis(2-ethylhexyl)phthalate is used in the production of polyvinyl chloride [PVC] materials and is a common laboratory contaminant, which may contribute to the elevated concentration detected in the MW-5 sample. Monitoring well MW-5 is located upgradient to the facility's operational areas.) Groundwater sample results for wells surrounding the formerly and currently operational area of the facility indicate that groundwater has not been impacted by facility-related activities.

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[2] "existing area of contaminated groundwater" is an area (with horizontal and vertical dimensions) that has been verifiably demonstrated to contain all relevant groundwater contamination for this determination, and is defined by designated (monitoring) locations proximate to the outer perimeter of "contamination" that can and will be sampled/tested in the future to physically verify that all "contaminated" groundwater remains within this area, and that the further migration of "contaminated" groundwater is not occurring. Reasonable allowances in the proximity of the monitoring locations are permissible to incorporate formal remedy decisions (i.e., including public participation) allowing a limited area for natural attenuation.

4. Does "contaminated" groundwater **discharge** into **surface water** bodies?

_____ If yes - continue after identifying potentially affected surface water bodies.

__X__ If no - skip to #7 (and enter a "YE" status code in #8, if #7 = yes) after providing an explanation and/or referencing documentation supporting that groundwater "contamination" does not enter surface water bodies.

_____ If unknown - skip to #8 and enter "IN" status code.

Rationale and Reference(s):
Two surface water bodies were identified within 0.5 miles of the operating area of the facility. Foxes Run is located approximately 0.4 miles east of the facility. Foxes Run flows eastward to its convergence with Darby Creek located approximately two miles east of the facility. Reeses Run is located approximately 0.15 miles northwest of the facility. Reeses Run flows southwesterly to its convergence with Crum Creek located approximately two miles southwest of the facility. Both surface water bodies are designated as cold water fisheries and are listed on the streams integrated list as attaining segments supporting aquatic life (eMapPA, 2011).

The headwaters for two other surface water bodies (Preston Run and Hunter Run) are located south of the facility across West Chester Pike. Both water bodies are tributaries to Crum Creek. Preston Run is a designated cold water fishery, while Hunter Run is designated as a warm water fishery. Both water bodies are listed on the streams integrated list as attaining segments supporting aquatic life (eMapPA, 2011).

There are three detention basins for retention of stormwater on the 312 acre property. Surface water runoff on the northern portion of the property flows to the north toward the northern most detention basin and Reeses Run. Surface water runoff on the remainder of the property flows to the south and is intercepted by the detention basins located on the eastern and southern portions of the property. The facility formerly held an NPDES permit for discharges of stormwater to the detention basins that was superseded by a no exposure certification approved by PADEP in 2004. There have been no known discharges related to the facility operations to the detention basins. Based on this information, direct discharges of site-related chemicals to the nearby surface water bodies and sediment are not expected to be of concern at this time.

Groundwater elevation data for the on-site monitoring wells indicate that groundwater flows to the south toward West Chester Pike and the headwaters of Preston Run and Hunter Run. Groundwater discharges to Reeses Run and/or Foxes Run are not expected, as these water bodies are located east and northwest of the facility.

Collection of rainwater and spills that may occur in the drum storage containment pads are channeled by a sloped floor that discharges the water into a drain which is directed into either the main underground sump located centrally on the south edge of the main drum storage area or the self-contained underground sump located north of the E-building. Fluids contained in these sumps must be manually pumped and discharged either to the main stormwater drainage system or the facility's wastewater pretreatment ASTs. The facility currently operates with a no exposure certification. Therefore, it is concluded that no controls are relevant for discharges of surface water runoff to nearby surface water bodies.

Sampling of the onsite groundwater monitoring wells indicates that bis(2-ethylhexyl)phthalate and barium were present above the PADEP non-residential MSCs in three of the wells. However, these two compounds were not detected at the nearest downgradient wells. In addition, it is believed that the presence of these compounds is not related to the operations formerly or currently conducted by the facility. Therefore, discharges of groundwater containing these two compounds to the surface water bodies south of the facility is not expected, and it is concluded that no controls are necessary at this time.

(Note: BPG plans further investigation of the groundwater contamination identified at the property, and has entered the property into the PADEP Act 2 Program.)

5. Is the **discharge** of "contaminated" groundwater into surface water likely to be **"insignificant"** (i.e., the maximum concentration[3] of each contaminant discharging into surface water is less than 10 times their appropriate groundwater "level," and there are no other conditions (e.g., the nature, and number, of discharging contaminants, or environmental setting), which significantly increase the potential for unacceptable impacts to surface water, sediments, or eco-systems at these concentrations)?

____ If yes - skip to #7 (and enter "YE" status code in #8 if #7 = yes), after documenting: 1) the maximum known or reasonably suspected concentration[3] of <u>key</u> contaminants discharged above their groundwater "level," the value of the appropriate "level(s)," and if there is evidence that the concentrations are increasing; and 2) provide a statement of professional judgement/explanation (or reference documentation) supporting that the discharge of groundwater contaminants into the surface water is not anticipated to have unacceptable impacts to the receiving surface water, sediments, or eco-system.

____ If no - (the discharge of "contaminated" groundwater into surface water is potentially significant) - continue after documenting: 1) the maximum known or reasonably suspected concentration[3] of <u>each</u> contaminant discharged above its groundwater "level," the value of the appropriate "level(s)," and if there is evidence that the concentrations are increasing; and 2) for any contaminants discharging into surface water in concentrations[3] greater than 100 times their appropriate groundwater "levels," the estimated total amount (mass in kg/yr) of each of these contaminants that are being discharged (loaded) into the surface water body (at the time of the determination), and identify if there is evidence that the amount of discharging contaminants is increasing.

____ If unknown - enter "IN" status code in #8.

Rationale and Reference(s):

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[3] As measured in groundwater prior to entry to the groundwater-surface water/sediment interaction (e.g., hyporheic) zone.

6. Can the **discharge** of "contaminated" groundwater into surface water be shown to be "**currently acceptable**" (i.e., not cause impacts to surface water, sediments or eco-systems that should not be allowed to continue until a final remedy decision can be made and implemented[4])?

____ If yes - continue after either: 1) identifying the Final Remedy decision incorporating these conditions, or other site-specific criteria (developed for the protection of the site's surface water, sediments, and eco-systems), and referencing supporting documentation demonstrating that these criteria are not exceeded by the discharging groundwater; OR
2) providing or referencing an interim-assessment,[5] appropriate to the potential for impact, that shows the discharge of groundwater contaminants into the surface water is (in the opinion of a trained specialists, including ecologist) adequately protective of receiving surface water, sediments, and eco-systems, until such time when a full assessment and final remedy decision can be made. Factors which should be considered in the interim-assessment (where appropriate to help identify the impact associated with discharging groundwater) include: surface water body size, flow, use/classification/habitats and contaminant loading limits, other sources of surface water/sediment contamination, surface water and sediment sample results and comparisons to available and appropriate surface water and sediment "levels," as well as any other factors, such as effects on ecological receptors (e.g., via bio-assays/benthic surveys or site-specific ecological Risk Assessments), that the overseeing regulatory agency would deem appropriate for making the EI determination.

____ If no - (the discharge of "contaminated" groundwater can not be shown to be "**currently acceptable**") - skip to #8 and enter "NO" status code, after documenting the currently unacceptable impacts to the surface water body, sediments, and/or eco-systems.

____ If unknown - skip to 8 and enter "IN" status code.

Rationale and Reference(s):

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[4] Note, because areas of inflowing groundwater can be critical habitats (e.g., nurseries or thermal refugia) for many species, appropriate specialist (e.g., ecologist) should be included in management decisions that could eliminate these areas by significantly altering or reversing groundwater flow pathways near surface water bodies.

[5] The understanding of the impacts of contaminated groundwater discharges into surface water bodies is a rapidly developing field and reviewers are encouraged to look to the latest guidance for the appropriate methods and scale of demonstration to be reasonably certain that discharges are not causing currently unacceptable impacts to the surface waters, sediments or eco-systems.

7. Will groundwater **monitoring** / measurement data (and surface water/sediment/ecological data, as necessary) be collected in the future to verify that contaminated groundwater has remained within the horizontal (or vertical, as necessary) dimensions of the "existing area of contaminated groundwater?"

    ____ If yes - continue after providing or citing documentation for planned activities or future sampling/measurement events. Specifically identify the well/measurement locations which will be tested in the future to verify the expectation (identified in #3) that groundwater contamination will not be migrating horizontally (or vertically, as necessary) beyond the "existing area of groundwater contamination."

    ____ If no - enter "NO" status code in #8.

    ____ If unknown - enter "IN" status code in #8.

Rationale and Reference(s):

8. Check the appropriate RCRIS status codes for the Migration of Contaminated Groundwater Under Control EI (event code CA750), and obtain Supervisor (or appropriate Manager) signature and date on the EI determination below (attach appropriate supporting documentation as well as a map of the facility).

__X__ YE Yes, "Migration of Contaminated Groundwater Under Control" has been verified. Based on a review of the information contained in this EI determination, it has been determined that the "Migration of Contaminated Groundwater" is "Under Control" at the __**Lyondell Chemical Company**__ facility, EPA ID # __**PAD046538211**__ located at __**3801 West Chester Pike, Newtown Square, Pennsylvania 19073**__ Specifically, this determination indicates that the migration of "contaminated" groundwater is under control, and that monitoring will be conducted to confirm that contaminated groundwater remains within the "existing area of contaminated groundwater". This determination will be re-evaluated when the Agency becomes aware of significant changes at the facility.

____ NO - Unacceptable migration of contaminated groundwater is observed or expected.

____ IN - More information is needed to make a determination.

Completed by (signature) ______________________ Date __________

(print) ______________________ __________

(title) ______________________ __________

Supervisor (signature) ______________________ Date __________

(print) ______________________ __________

(title) ______________________ __________

(EPA Region or State) ______________________ __________

Locations where References may be found:

USEPA Region III
Waste and Chemical Mgmt. Division
1650 Arch Street
Philadelphia, PA 19103

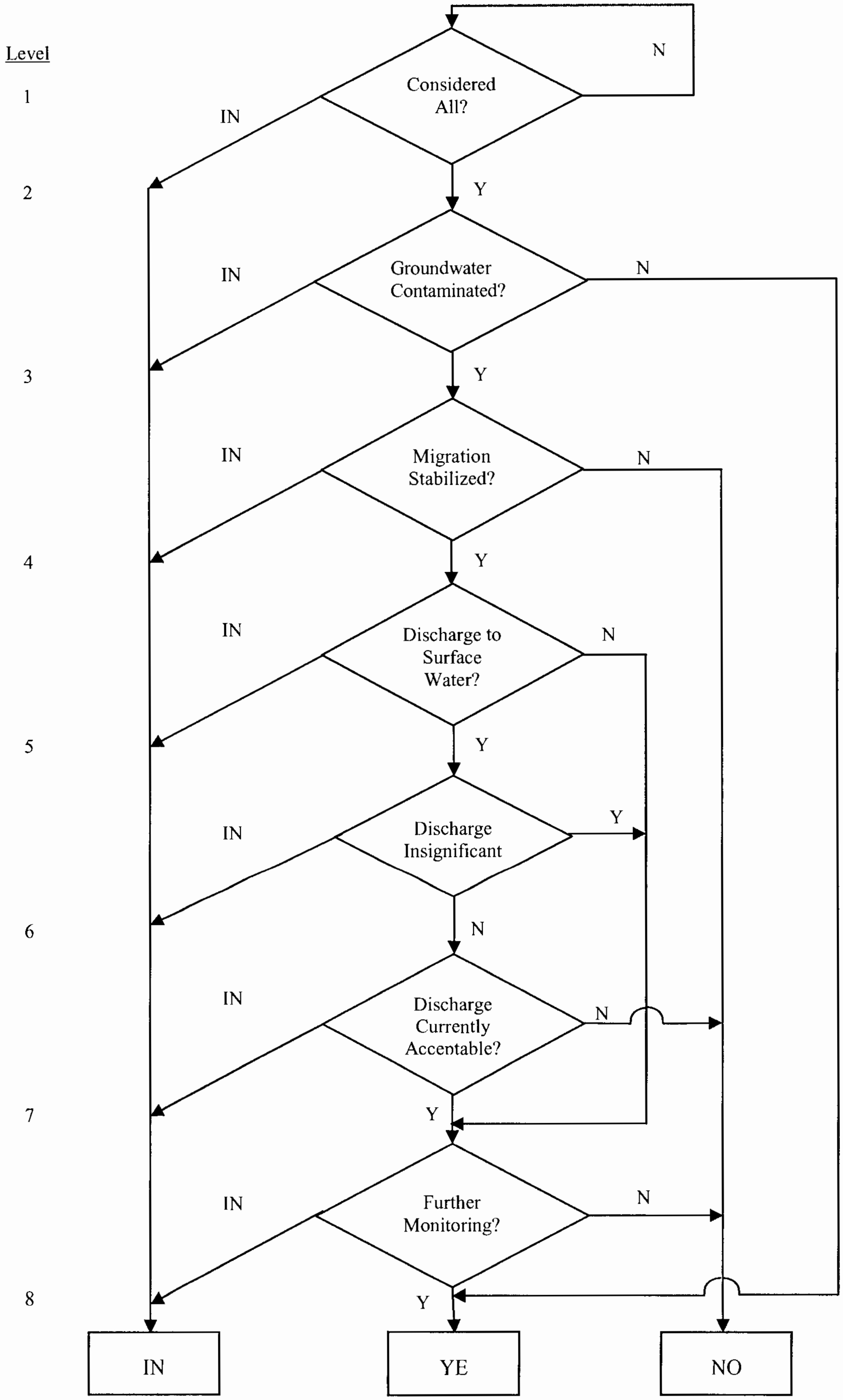
PADEP
South East Regional Office
2 East Main Street
Norristown, PA 19401

Contact telephone and e-mail numbers

(name) ______________________
(phone#) ______________________
(e-mail) ______________________

Facility Name: Lyondell Chemical Company
EPA ID# PAD046538211
City/State Newtown Square, PA 19073

MIGRATION OF CONTAMINATED GROUNDWATER UNDER CONTROL (CA 750)



EVALUATING THE VAPOR INTRUSION TO INDOOR AIR PATHWAY

Primary Screening – Question #1

Q1: **Are chemicals of sufficient volatility and toxicity** (Table 1) known or reasonably suspected to be present in subsurface soils, soil gas, or ground water; the presence of these chemicals having resulted from releases subject to RCRA Corrective Action (e.g., from Solid Waste Management Units (SWMU), Regulated Units (RU), or Areas of Concern (AOC))?

X If YES - check here, check the relevant chemicals on Table 1, and continue with Question 2 below;

_____ If NO - check here, provide rationale and references below, and skip to the Pathway-Specific EI Summary Page and document that the subsurface vapor to indoor air pathway is incomplete; or

_____ If sufficient data are not available, skip to the Pathway-Specific EI Summary Page and enter "IN" (more information needed) status code.

Criteria:

Table 1 provides a list of chemicals and indicates whether they are sufficiently volatile and toxic to pose an incremental lifetime cancer risk greater than 10^{-5} or a hazard index (HI) greater than 1, assuming continuous exposure to the maximum possible vapor concentration. This is an extremely conservative criterion, corresponding to an infinite supply of the pure chemical (e.g., NAPL pool), and no indoor air dilution, which is highly unlikely to occur. The exposure assumptions and calculations are documented in Appendix B.

Note: Table 1 may not include all possible chemicals of concern; it can be revised to include other chemicals according to the methods described in Appendix B, if the necessary chemical property and toxicity data is available.

Rationale and References:

Lyondell Chemical Company (Lyondell or facility) is situated on 312 acres of land located at 3801 West Chester Pike, Newtown Square, Newtown Township, Delaware County, Pennsylvania. The property was ultimately subdivided into two separate parcels. The western 112 acres of the property (west of the main entry road) are currently owned and occupied by SAP America, Inc. (SAP). The eastern 200 acres of the property (east of the main entry road) are currently owned by BPG Real Estate Investors Straw Party 1 LP (BPG). Lyondell, along with multiple separate operating entities (e.g., Graham Partners, Catholic Health East and Medstaff, SAP, and the Ellis Athletic Center), currently lease building space from BPG. Note: Non-facility buildings in the complex included the Cottages, Gymnasium, Training Center, Auditorium, and Medical Building (also referred to as the Dispensary).

The facility is bordered to the north by vacant land and residences. Properties to the east, west, and south of the facility are primarily residential with some commercial properties intermixed. Bryn Mawr Hospital Health Center is located directly south of the facility on BPG's property. The remainder of the property owned by BPG has been approved for redevelopment, which will include office, retail, and residential uses. Currently, the property consists of approximately 20 percent impermeable surfaces (buildings and paved areas) and 80 percent permeable surfaces (vegetation and stormwater ponds).

From 1921 through 1977, the property on which the facility is located was the campus of the Ellis School for Fatherless Girls. The property was purchased in October 1978 by Atlantic Richfield Company (ARCO). ARCO began operating at the facility in 1981 as a research and development (R&D) center focusing on chemicals (primarily propylene oxide and its derivatives) that are used to make consumer end products. Research conducted at the facility ranged from small bench-scale experiments performed in its laboratories to pilot plants. No commercial manufacturing took place at the facility.

In October 1987, ARCO spun-off its chemicals division, transferring substantially all of the assets and liabilities of the ARCO Chemical Division of Atlantic Richfield Company. At this time, the facility began operating under the name of ARCO Chemical Company (ACC). ARCO retained ownership of the property

and leased the facilities to ACC. In October 1997, ARCO (later bought by British Petroleum [BP]) sold the western half of the property (west of the main entry road) to SAP on which it constructed its headquarters building. The remaining eastern half of the property (east of the main entry road), including the ACC lease, was ultimately sold to SAP in March 2000. In July 1998, Lyondell Chemical Worldwide, Inc. acquired ACC, with ACC becoming a wholly-owned subsidiary of Lyondell Chemical Worldwide, Inc. and Lyondell assuming ACC's lease. In December 1999, Lyondell Chemical Worldwide, Inc. was merged into Lyondell Chemical Company. Lyondell Chemical Company continued to lease the facility from SAP.

In June 2004, SAP sold approximately 200 acres of the 312-acre property, including the buildings leased by the facility and its lease, to BPG. SAP retained the remaining 112 acres where they constructed their current headquarters building. The 200 acre property (east of the main entry road) is currently owned by separate limited partnerships affiliated with BPG Properties Ltd. and managed by BPG Management Company L.P. The Lyondell-leased areas of the facility are operated by Lyondell Chemical Company, an indirect wholly-owned subsidiary of LyondellBasell Industries. N.V. (LyondellBasell). (Note: Lyondell merged with Basell Polyolefins in December 2007, but continued to operate under the name of Lyondell Chemical Company.) SAP currently owns the western 112 acres of the 312 acre property.

The facility continues to serve as a R&D center for the company's chemicals and fuels businesses. R&D work (which is either conducted in the facility's laboratories, bays, high pressure cells, or pilot plants) focuses on improving the technology used to manufacture raw materials for consumer end products such as plastics, furniture foams, athletic footwear, paints, cosmetics, fabrics, gasoline and more. No commercial manufacturing takes place at this facility.

The facility is a large quantity generator (LQG) of various types and quantities of chemical wastes. Wastes are stored in small containers (e.g., lab packs) and in 55-gallon drums until shipped off-site by licensed transporters for disposal at permitted facilities. In general, wastes generated at the facility have included acetone, isopropyl methanol, styrene, toluene, methylene chloride, acetone isopropanol, mixed amines, polyester resin, chloroform, methyl alcohol, allyl alcohol, toluene, diisocyanate, acetaldehyde, propylene oxide, propylene, isobutylene, n-butane, and petroleum hydrocarbons. Wastes are generated in the laboratories and bays located in the B-building and the pressure cells, and the E-building pilot plants. The wastes are stored in satellite accumulation areas until they are transferred to the main waste storage area located outside and north of the B-building. Wastes generated in the E-building pilot plants are temporarily stored in the separate smaller drum storage area (known as the E-pad) located outside the northwest corner of the E-building, and are transferred daily to the main drum storage area. Two releases (one-liter container of acryloyl chloride and approximately six gallons of propylene oxide) were reported at the facility that were contained on concrete surfaces and immediately cleaned up.

Non-contact industrial cooling water and wastewater from the facility's laboratories and pilot plants are stored in two wastewater pretreatment aboveground storage tanks (ASTs) located behind (north of) the E-building. The wastewater pretreatment system consists of two open-top steel ASTs, one of 143,000-gallon capacity (interim tank) and one of 36,000-gallon capacity (overflow tank). The non-contact cooling water and laboratory wastewater is directed via underground drains to the 143,000-gallon AST which acts as a settling and equalization tank before the water is discharged daily under permit to the Delaware County Regional Water Quality Control Authority (DELCORA) Publicly Owned Treatment Works (POTW). The smaller AST (36,000-gallon AST) is available for overflow purposes. Facility representatives indicate the smaller holding tank is typically empty.

In 1990 and 1992, ARCO removed and/or upgraded multiple underground storage tanks (USTs) on the property. Extensive contamination was identified in the excavation for two 7,500-gallon USTs located at the Training Center. Separate phase liquid (SPL) was observed flowing beneath the fill pipe of one of the USTs. Initial post-excavation samples showed concentrations of total petroleum hydrocarbons (TPH) ranging from 16 parts per million (ppm) to 10,706 ppm. The contaminated soil was excavated until post-excavation soil samples were below 100 ppm. (Note: A TPH concentration of 377 ppm was detected in one of the post-excavation floor samples, and additional soil was reportedly removed in the vicinity of this sample. However, there was no documentation that confirmatory soil samples were collected from this area prior to backfilling the excavation.)

Post-excavation soil samples collected at the Dispensary UST excavation showed TPH concentrations were 11 ppm. However, initial post-excavation soil samples collected at the President's House UST excavation showed TPH concentrations of 911 ppm and 1,246 ppm. Accordingly, additional soil was removed until post-excavation soil samples showed TPH concentrations below 100 ppm (27 ppm and 39 ppm). PADEP determined that no further action was necessary for the four USTs. During this time, ACC also removed two 550-gallon ASTs that contained gasoline and diesel fuel in the area referred to as the Contractor's Area (currently the property owned and operated by SAP located west of the main entrance road). While removing the original ASTs, gasoline-impacted soil was observed, and approximately 120 yards of soil were excavated. No additional information (particularly related to confirmatory soil sampling) was provided in the report. Groundwater was not encountered during the investigation; therefore, no groundwater investigation was conducted at that time.

In November 1992, ACC removed seven additional USTs that contained the facility's raw and waste materials located behind (north of) the E-building. The USTs contained light gasoline/oil; hexane; cyclopentane; waste solvent; styrene; pentane; and xylene/toluene. The USTs appeared to be in good condition and no evidence of contamination was observed. All piping was aboveground. Volatile organic compounds (VOCs) were not detected in post-excavation soil samples collected from beneath each UST. On March 8, 1993, PADEP issued a no further action determination for the seven USTs. Groundwater was not encountered during the investigation; therefore, no groundwater investigation was conducted at that time. The four USTs that remain are currently empty and are registered with PADEP.

In March 1998, while ACC was upgrading the equipment for the two 30,000-gallon fuel oil USTs adjacent to the boiler house, indications of a release were observed. Polynuclear aromatic hydrocarbons (PAHs) were identified in soil samples collected from the excavation area. However, none of the detected concentrations were above the PADEP direct contact residential and non-residential subsurface soil (2 to 15 feet) medium specific concentrations (MSCs) or the soil to groundwater, used aquifer, total dissolved solids (TDS) less than 2,500 milligrams per liter (mg/L) residential MSCs.

Groundwater was not encountered during the UST removals; therefore, no groundwater investigations were conducted at that time. The current property owner (BPG) identified 15 groundwater monitoring wells on the property that were installed by previous property owners in 1997 (MW-104, MW-105, and MW-107) and 2000 (MW-1 through MW-11, and MW-4D). The wells range in depth from 28 to 60 feet bgs. BPG contracted IES Engineers (IES) to collect one round of groundwater samples to determine the groundwater quality at the property. IES collected samples from 13 of the 15 wells in October 2010. One of the wells (MW-8) could not be located, and MW-1 was not sampled because approximately 0.5 inches of SPL was encountered in the well. (Note: MW-1 is located in the vicinity of the former 7,500-gallon fuel oil USTs removed at the Training Center in 1990. There are no wells downgradient of MW-1.) The static water levels gauged in October 2010 ranged from 16.59 feet bgs on the northern portion of the property to 33.61 feet bgs at on the southern portion of the property. The interpreted direction of groundwater flow was to the south.

Several VOCs and SVOCs (chloroform, benzo(a)anthracene, bis(2-ethylhexyl)phthalate, dimethyl phthalate, and 2,6-dinitrotoluene) were detected in the 2010 groundwater samples. The concentrations were below the PADEP used aquifer, residential and non-residential MSCs except bis(2-ethylhexyl)phthalate, which was detected in one well (32 ug/L at MW-5) above the MSC of 6 ug/L. IES stated that the source for the bis(2-ethylhexyl)phthalate was unknown; however, MW-5 is located upgradient to the facility's operational areas. Therefore, it is not expected to be related to facility operations. In addition, bis(2-ethylhexyl)phthalate is not listed as a compound of concern in the PADEP guidance and is not a chemical of sufficient toxicity or volatility according to the USEPA vapor intrusion guidance. No other VOCs or SVOCs were detected in the groundwater samples above the PADEP residential and non-residential groundwater MSCs.

EIS sampled 14 groundwater monitoring wells again November and December 2011 to evaluate the groundwater quality at the property. This time, MW-1 was sampled twice, in November and December 2011. Benzene (0.42 ug/L, 0.52 ug/L) was detected below the reporting limit, but greater than or equal to the method detection limit. The concentrations are below the used aquifer, residential and non-residential MSCs of 5 ug/L. No other monitoring wells samples detected benzene and only the MW-9 samples from both sampling events detected chloroform (2.4 ug/L and 1.1 ug/L) below the used aquifer, residential and non-residential MSCs of 80 ug/L.

The groundwater samples did detect SVOCs, most being detected in MW-1: acenaphthene, acenaphylene, bis(2-ethylhexyl)phthalate, 2-chlorophenol, di-n-butyl phthalate, fluorine, 2-methylnaphthalene, naphthalene, and phenanthrene; all SVOCs were below the respective used aquifer, residential and non-residential MSCs. Bis(2-ethylhexyl)phthalate and di-n-butyl phthalate were detected in the sample collected from MW-10, below the used aquifer, residential and non-residential MSCs. Only di-n-butyl phthalate was detected in MW-104, used aquifer, residential and non-residential MSCs.

Based on the information provided above, the vapor intrusion pathway is not of concern for the buildings located on the property.

(Note: The fuel oil USTs were installed by the school prior to ARCO's purchase of the property. Ownership of the areas where the fuel oil USTs were removed was transferred to the subsequent property owners [SAP, and later BPG]. After the identification of SPL in monitoring well MW-1, BPG submitted a Notice of Intent to Remediate (NIR) to PADEP in January 2011. The NIR stated that BPG intends to demonstrate attainment of the PADEP Statewide Health Standards (SHS) for groundwater (and soil if found to be contaminated) under the PADEP Voluntary Cleanup (Act 2) Program. This will include additional groundwater characterization, soil sampling in the vicinity of the Training Center fuel oil USTs, and analyzing the samples for the individual constituents of No. 2 fuel oil.)

Primary Screening – Question #2

Q2: Are inhabited buildings located near subsurface contaminants having sufficient volatility and toxicity?

_____ If YES - check here, identify buildings below, and continue with Question 3 below.

__X__ If NO – check here and skip to the Pathway-Specific EI Summary Page and document that the subsurface vapor to indoor air pathway is incomplete, or

_____ If sufficient data are not available - check here and skip to Pathway-Specific EI Summary Page and enter "IN" (more information needed) status code.

Criteria:

The goal of this question is to identify buildings that could potentially have a complete pathway, i.e., indoor air concentrations above levels that would pose a lifetime incremental cancer risk of 10^{-5}, or a hazard index of >1. For the purposes of this question:

- **"inhabited buildings"** are structures with enclosed air space that are designed for human occupancy.
- **"subsurface contaminants having sufficient volatility and toxicity"** are defined by Table 1 and were discussed above in Question 1.
- An inhabited building is considered **"near"** subsurface contaminants if it is located within 100 ft laterally of known or interpolated soil gas or groundwater concentrations in excess of the criteria in Table 2.

A distance criterion is necessary to focus the assessment on buildings most likely to have a complete pathway. Vapor concentrations generally decrease with increasing distance away from a subsurface vapor source, and at some distance, the concentrations become negligible. The distance at which concentrations are negligible is a function of the mobility, toxicity and persistence of the chemical, as well as the geometry of the source, subsurface materials, and characteristics of the building of concern. Definitive studies on this topic have yet to be conducted, but 100 feet is a reasonable criterion when considering vapor migration fundamentals, typical sampling density, and uncertainty in defining the actual contaminant spatial distribution.

Identify Inhabited Buildings Within Distances of Possible Concern:

The Training Center Building is adjacent/west/sidegradient of MW-1. The closest downgradient buildings are more than 150 away from MW-1. (Note: The BPG representative indicated that the Training Center building is currently vacant and used only for storage at this time. This building is expected to be demolished in the future.) None of the buildings are believed to be inhabited.

Primary Screening Stage— Question #3

Q3. Is **immediate action warranted** to mitigate current risks to residents of those buildings identified in Question 2 to be located within the area of concern?

_____ If YES – check here and proceed with immediate actions to verify or eliminate imminent risks, which may include indoor air quality monitoring, engineered containment or ventilation systems, or relocation of receptors[1]. The immediate action(s) should be appropriate for the situation.

X If NO – check here and then continue with Question 4 below.

Criteria:

Here we focus on those buildings identified in Question 2 to be located within the areas of concern. The following qualitative criteria are considered sufficient to justify immediate actions:

Odors reported by occupants, particularly if described as "chemical", or "solvent", or "gasoline". The presence of odors does not necessarily correspond to adverse health and/or safety impacts and the odors could be the result of indoor vapor sources; however, it is prudent to investigate any reports of odors as the odor threshold for some chemicals exceeds their respective acceptable target breathing zone concentrations.

Physiological effects reported by occupants (dizziness, nausea, vomiting, confusion, etc.).

Wet basements, in areas where chemicals of sufficient volatility and toxicity (see Table 1) are known to be present in groundwater and the water table is shallow enough that the basements are prone to groundwater intrusion or flooding, especially if there is evidence of light, non-aqueous phase liquids (LNAPLs) floating on the water table directly below the building, and/or any direct evidence of contamination (liquid chemical or dissolved in water) inside the building.

Short-term safety concerns are known, or are reasonably suspected to exist - for example: a) explosive or acutely toxic concentrations of vapors have been measured in the building or connected utility conduits; b) explosive or acutely toxic levels of vapors are likely to be present in utility conduits, sumps, or other subsurface drains directly connected to the building. Lower explosive limits are typically in the range of 1 to 5% by volume (10,000,000 ppbv to 50,000,000 ppbv).

There may be circumstances in which the Responsible Party elects to initiate indoor air quality monitoring and/or pro-actively eliminate exposures through avoidance or mechanical systems, rather than pursue continued assessment of the pathway. In some cases this may be a cost-effective option as it leads directly to an incomplete subsurface vapor to indoor air pathway. This option is available at any time in the assessment. Furthermore, some buildings are positively pressurized as an inherent design of the heating, ventilating and air conditioning system, and it may be possible to show that the pathway is incomplete by demonstrating a significant pressure differential from the building to the subsurface. Proactive indoor air quality monitoring may also be initiated at any time, although it is not necessary if the pathway can be confirmed to be incomplete using other data.

Rationale and Reference(s):

None of the buildings are permanent residences.

Q4: Do measured or reasonably estimated indoor air, soil gas, or ground water concentrations[2] exceed the target media-specific concentrations given in Table 2?

X If NO, and there is no reason to believe that the conservative attenuation factor of 0.01 is inappropriate– document representative media concentrations on Table 2 and check here. Go to the Pathway-Specific EI Summary Page and document that the subsurface vapor to indoor air pathway is incomplete.

____ If YES – check here. If indoor air concentrations are known and these are greater than the target indoor air concentrations, then the pathway is complete and engineering controls or avoidance measures need to be implemented. If only soil gas or groundwater data are available, and these exceed the target criteria, document representative media concentrations on Table 2 and then proceed to Question 5.

____ If sufficient data are not available - check here and skip to Pathway-Specific EI Summary Page and enter "IN" (more information needed) status code.

Criteria:

Question 4 is intended to allow a rapid screening of available site data, which may include soil gas, groundwater, or indoor air concentrations. Concentrations in the three media are assumed to be correlated, so that data from any of the three media can be used. If data are available for more than one media, all of the data should be considered in answering Question 4. As discussed in Appendix A, confidence in the assessment increases with multiple lines of evidence, so additional data may be collected for consideration in Question 4, at the discretion of either the responsible party or the lead regulatory authority, to the extent that this may be necessary and appropriate.

Note that it is important to segregate the buildings of interest into two categories: a) buildings lying above areas where contaminated groundwater is the only source of contaminant vapors, and b) buildings lying above areas where contaminated vadose (unsaturated) zone vapor sources are present. While indoor air quality data can be used to judge the pathway completeness in either case, the appropriate use of groundwater and soil gas data is different for these two cases. In case (a) either the soil gas or groundwater criteria in Table 2 can be used at this step, while in case (b) only soil gas criteria and soil gas samples collected above the vapor source zone can be used. This is because the groundwater criteria have been derived assuming no other vapor sources between the water table and the building foundation. This also applies for Question 5.

The term "measured or reasonably estimated" is used above (and throughout this document) as it is recognized that measurements at all buildings of concern may not be practical or necessary. For example, groundwater concentrations beneath buildings are commonly estimated from concentrations collected in wells distributed about a larger area of interest. Likewise, one might reasonably estimate upper bound indoor air concentrations for a group of buildings based on the measurements taken from those buildings expected to have the highest concentrations.

In the case of soil gas concentrations, measured or reasonably estimated soil gas concentrations at any depth in the subsurface may be used in Question 4, provided that this depth falls below the foundation depth. As there are concerns about the integrity of shallow soil gas samples, it is recommended that samples collected at depths <5 ft below ground surface (BGS) not be used for this analysis, unless they are collected immediately below the building foundation several feet in from the edge. Samples from fixed probes are also preferable, but not required. With respect to the spatial distribution of sampling points, close proximity to the building(s) of concern is preferred; however, it may be possible to reasonably estimate concentrations based on data from soil gas samples collected about a larger area. Users should also consider that, in general, samples collected at depth closer to the vapor source are much less likely to be dependent on the surface cover (i.e. pavement, lawn, foundation) than shallow soil gas samples.

In the case of groundwater concentrations, these should be measured or reasonably estimated using samples collected from wells screened at, or across the top of the water table. This is necessary to be consistent with the derivation of the target groundwater criteria in Table 2. Samples from groundwater monitoring wells may be a blend of groundwater from different levels across the screened interval. Confidence in the results can be increased through use of a more narrowly screened interval across the water table, or a variety of other depth-discrete sampling protocols. These issues, and others to be considered during data collection, are discussed in Appendix A.

Question 4 calls for comparison with the target criteria given in Table 2; however, this guidance is not intended to supersede existing state-specific guidance or regulations. Thus, the lead regulatory agency will determine the appropriate criteria to be used here and in Questions 5 and 6. If target criteria are not available, then the tables provided with this guidance should be used. A regulatory agency may have already developed acceptable indoor air concentrations, but they might not have derived vapor intrusion pathway-specific target media concentrations. In this case, the methods discussed in Appendix B can still be used to derive target soil gas and dissolved groundwater concentrations consistent with those existing target indoor air concentrations. Where pathway-specific media concentrations already exist, the values provided in this guidance should be considered national benchmarks, and the governing regulatory authority should compare the methods and assumptions used to derive their criteria with the methods used in this guidance. In any case, users of this guidance should review the methods used to derive the tables presented in this guidance, and consider whether or not the assumptions and methods are appropriate for their application. These assumptions are discussed briefly below, and in more detail in Appendix B.

The target media-specific concentrations given in Table 2 correspond to indoor air concentrations calculated to cause an incremental lifetime cancer risk of 10^{-5} or a Hazard Index of 1.0 (whichever is more restrictive). In the case of the soil gas criteria, a conservative soil gas to indoor air attenuation factor of 0.01 is used. For the groundwater criteria, there is an additional conservative assumption that the partitioning of chemicals between groundwater and soil vapor is assumed to obey Henry's Law. Table 2 may not include all possible chemicals of concern; it can be revised to include other chemicals of concern according to the methods described in Appendix B, if chemical property and toxicity data is available.

The soil gas to indoor air attenuation factor represents the ratio of the indoor air concentration to the soil gas concentration at some depth. The 0.01 value is considered to be a reasonable upper-bound value for the case where the soil gas concentration immediately beneath a foundation is used (e.g., the indoor air concentration would not be expected to exceed 1/100 of the concentration immediately below the foundation). This value is based on available data from sites where paired indoor air and soil gas samples immediately below a foundation were available, and also theoretical considerations. It is a conservative enough criterion that it should be protective even in settings where the building has significant openings to the subsurface. In addition, since it has been argued that the 0.01 value is conservative for deriving near foundation soil gas criteria, the soil gas criteria derived using this value would be even more conservative if applied to soil gas concentrations measured or reasonably estimated at any other deeper depth. For reference, attenuation factors as low as 0.00001 have been determined from data at some sites. There may be some settings where the 0.01 attenuation factor is not a conservative upper-bound value; however, most of these settings would presumably be identified and addressed in Question #3.

The authors of this guidance felt that the uncertainties associated with soil partitioning calculations as well as the uncertainties associated with soil sampling and soil chemical analyses (see EPA/600/SR-93/140) were so great that use of soil concentrations for assessment of this pathway is not technically defensible. Thus, soil concentration criteria were not derived and the use of soil criteria is not encouraged. However, as discussed above, this guidance is not intended to supersede existing State guidance, and users should follow the appropriate guidance as determined by the lead regulatory authority. Furthermore, proponents may elect to defend the use of soil concentration data in the Site-Specific Pathway Assessment, Question 6.

The soil gas and groundwater target concentrations were derived from the target indoor air criteria, without consideration of ambient outdoor air quality or other chemical sources internal to the building. The target concentrations should therefore be interpreted as target incremental concentrations above background levels. To be consistent with that definition, background concentrations should be subtracted from measured or reasonably estimated indoor air concentrations before comparison against the Table 2 (or other appropriate) criteria.

Values appearing in Table 2 were derived for an incremental lifetime cancer risk (R) of 1×10^{-5} and hazard index (HI) of 1. The risk-manager or decision-maker should consider a number of variables when comparing site data to the Table 2 criteria, including: the number and locations of samples, the spatial and temporal variability of concentrations, the frequencies of exceedances of Table 2 criteria, the magnitude of exceedances of Table 2 criteria, and the degree of conservatism built into Table 2 values. The Table 2 criteria are not intended for use as "bright-line criteria", below which any measured or reasonably estimated concentrations are acceptable and above which any concentrations are unacceptable. Instead, professional judgment should be used when applying the criteria. For example, if eight out of ten samples satisfy Table 2 criteria and the other two exceed the criteria, but only by a factor of two or three, the risk-manager might decide that the pathway is incomplete, even though two of the samples exceed the criteria. This is because the risk estimate is still in the same order-of-magnitude as the target risk level and there is some conservatism built into the Table 2 values.

Rationale and Reference(s):

Benzene and chloroform are listed as chemicals of sufficient toxicity or volatility according to the USEPA vapor intrusion guidance. Chloroform was detected at a low concentration (2.4 micrograms per liter [ug/L]) in one well (MW-9) during one sampling event. Benzene concentrations in MW-1 are below the used aquifer, residential and non-residential MSCs of 5 ug/L. The detected concentrations are below corresponding "Target Groundwater Concentration Corresponding to Indoor Air Concentration" listed on Table 2.

Secondary Screening – Question #5

Q5: Using the appropriate scenario-specific attenuation factor (from Figure 1), do measured or reasonably estimated soil gas or ground water concentrations exceed the target media-specific concentrations given in Table 3?

______ If NO, and there is no reason to believe that the scenario-specific attenuation factor is inappropriate, check here and document the Rationale and References for the scenario-specific attenuation coefficient below. Go to the Pathway-Specific EI Summary Page and document that the subsurface vapor to indoor air pathway is incomplete.

______ If YES – check here, and if representative measured or reasonably estimated soil gas and/or groundwater concentrations are considerably (i.e. greater than 100 times) higher than the values in Table 3 then interim exposure controls and/or measurement of indoor air quality monitoring should be conducted as soon as practicable; and when representative media concentrations are less than 100 times the appropriate Table 3 values proceed to further analysis and modeling in Question 6.

______ If sufficient data are not available - check here and skip to Pathway-Specific EI Summary Page and enter "IN" (more information needed) status code.

Criteria:

Soil gas or groundwater to indoor air attenuation factors are expected to depend on building characteristics, chemical type, soil type, and depth of the source (which is defined as either a measured soil gas concentration at the specified sample collection depth below the building, or the ground water concentration at the depth of the water table). The 0.01 attenuation factor value used in Question 4 is representative of expected upper bound values for vapors located immediately below the building, and therefore does not depend on soil type or depth. Question 5 considers the site-specific soil type and depth of source to allow for a more representative vapor attenuation factor, and consequently the target media concentrations. The target indoor air concentrations remain the same (unchanged from Table 2), but target soil gas and groundwater concentrations will vary with changes in the vapor attenuation factor.

Attenuation factors have been calculated for some combinations of source depth, soil type, and building characteristics using the Johnson and Ettinger (1991) model. Reasonable building characteristics were selected and held constant in these calculations and the chemicals were assumed not to degrade. To capture the effect of changes in soil properties, the U.S. Soil Conservation Service (SCS) soil texture classifications were considered, and a subset of these were selected. This subset was chosen so that their relevant properties (porosity and moisture content) would collectively span the range of conditions most commonly encountered in the field. Then, plots of attenuation factor vs. depth were calculated and these results are presented below in Graphs 1a (for use of soil gas data) and 1b (for use of groundwater data). The two graphs are different because the first does not have to account for transport across the capillary fringe.

Details of these calculations are included in Appendix B. The depth used should be: a) the vertical separation between the soil gas sampling point and the building foundation for use of Graph 1a, or b) the vertical separation between groundwater and the building foundation for use of Graph 1b. Samples collected near to, but at depths shallower than the building foundation should not be used. Table 4 should be used to help select the most appropriate soil texture classification as discussed below.

The site characterization should include collection of soil samples at various depths between the building foundation elevation and contamination source (i.e., vertical soil gas and/or groundwater quality profiling) and description of soil lithology. The preferred method for determining the SCS soil class is to use lithological information combined with the results of grain size distribution tests on selected soil samples. Procedures for conducting grain size distribution tests are provided in American Society for Testing and Materials (ASTM) Standard Test Method for Particle Size Analysis of Soils (D422-63) and U.S. Natural Resources Conservation (NRCC) Soil Survey Laboratory Methods Manual, Soil Survey Laboratory Investigations Report No. 42.

The U.S. SCS soil texture classes are based on the proportionate distribution of sand, silt and clay sized particles in soil. It does not include any organic matter. The grain size boundaries are as follows:

Sand:	0.05 mm to 2 mm
Silt:	0.002 mm to 0.05 mm
Clay:	<0.002 mm

The soil textural classes are displayed in the SCS soil textural triangle. The soil texture class is determined by plotting the grain size distribution results on the soil texture triangle. If a soil texture class is not intersected based on the five classes included in the guidance, the nearest soil class is chosen. The selection of the soil texture class should be biased towards the coarsest soil type of significance, as determined by the site characterization program.

There are sites where different soil classifications systems have been used, and where information on soil lithology and grain size distribution is limited. Most engineering soil classification systems are either based on grain size, or a combination of grain size and engineering properties (e.g., Unified Soil Classification System (USCS), ASTM D2488-84, NAVFAC DM7.2 (1982)). For several soil classification systems, soil is divided into a coarse-grained fraction consisting of sand and gravel (or larger) particles (greater than 0.075 mm size) and fine-grained fraction consisting of silt and clay (less than 0.075 mm size). Soils are characterized as fine-grained if more than 50 percent is less than 0.075 mm in size. Various descriptors of particle size proportions such as trace, few, little, some, or use of the grain size class as an adjective or noun are often used to describe different soil types. In some cases engineering properties are also used to determine the appropriate soil type description. Unfortunately, there are widespread differences in both the soil classification systems used to describe soils and differences in the quality of lithological descriptions incorporated in boring logs. To assist users of guidance in cases where lithological and grain size information is limited, Table 4 below provides guidance that can be used to select, in appropriate terms, the appropriate soil texture class.

Table 4. Guidance for selection of soil type curves in Graphs 1a and 1b.

If your boring log indicates that the following materials are the predominant soil types . . .	then you should use the following texture classification when obtaining the attenuation factor
Sand or Gravel or **Sand and Gravel**, with less than about 12% fines, where "fines" are smaller than 0.075 mm in size.	Sand
Sand or Silty Sand, with about 12% to 25% fines	Loamy Sand
Silty Sand, with about 20% to 50% fines	Sandy Loam
Silt and Sand or Silty Sand or Clayey, Silty Sand or Sandy Silt or Clayey Sandy Silt, with about 45 to 75% fines	Loam
Sandy Silt or Silt, with about 50 to 85% fines	Silt Loam

We note that there is no soil texture class represented as consisting primarily of clay. Exclusion of clay was deliberate since homogenous, unfractured clay deposits are rare. Users of this guidance have the option to refine selection of soil properties as part of the Site Specific Pathway Assessment.

The user must defend their scenario choice with site-specific data. Given the approximate nature of this approach, users should round their attenuation factor to the nearest half order-of-magnitude (0.01, 0.003, 0.001, 0.0003, or 0.0001), selecting the higher number if the best estimate is between two increments. Then, the columns in Table 3 can be used to determine the appropriate target media concentrations. Values in Table 3 were derived as discussed in Appendix B.

Interim exposure controls and/or measurement of indoor air quality should be conducted as soon as practicable if measured or reasonably estimated soil gas and/or groundwater concentrations are considerably (i.e. greater than 100 times) higher than the values in Table 3 since the Site-Specific Assessment step is very unlikely to result in an attenuation factor that is 100 times smaller than the attenuation factor determined at this stage. This is especially true for any chemical (degradable or not) when shallow (e.g., <2 ft beneath the building foundation) soil gas concentrations are being used for assessment.

If the media concentrations being used are from a significant depth and the chemicals of concern are known to degrade aerobically, it is possible for the actual attenuation factor to be considerably less than the value determined in this step. However, this issue should be addressed through vertical soil gas profile sampling involving shallower samples in this question (or other direct empirical evidence and supporting data to show the profile of oxygen, carbon dioxide, or other indicators of microbial activity are adequate to validate conceptual models based on analogous case studies in similar settings, in Question 6). Again, if shallow soil gas samples are being used, it is unlikely that degradation will contribute significantly to increased attenuation between the sampling point and the building.

It should also be recognized that it may be less expensive (or more desirable for other reasons) to install and operate exposure controls than to conduct further assessment. This guidance neither requires nor precludes such an approach, and it is left to the discretion of the responsible party to decide if proactive exposure controls are cost-effective.

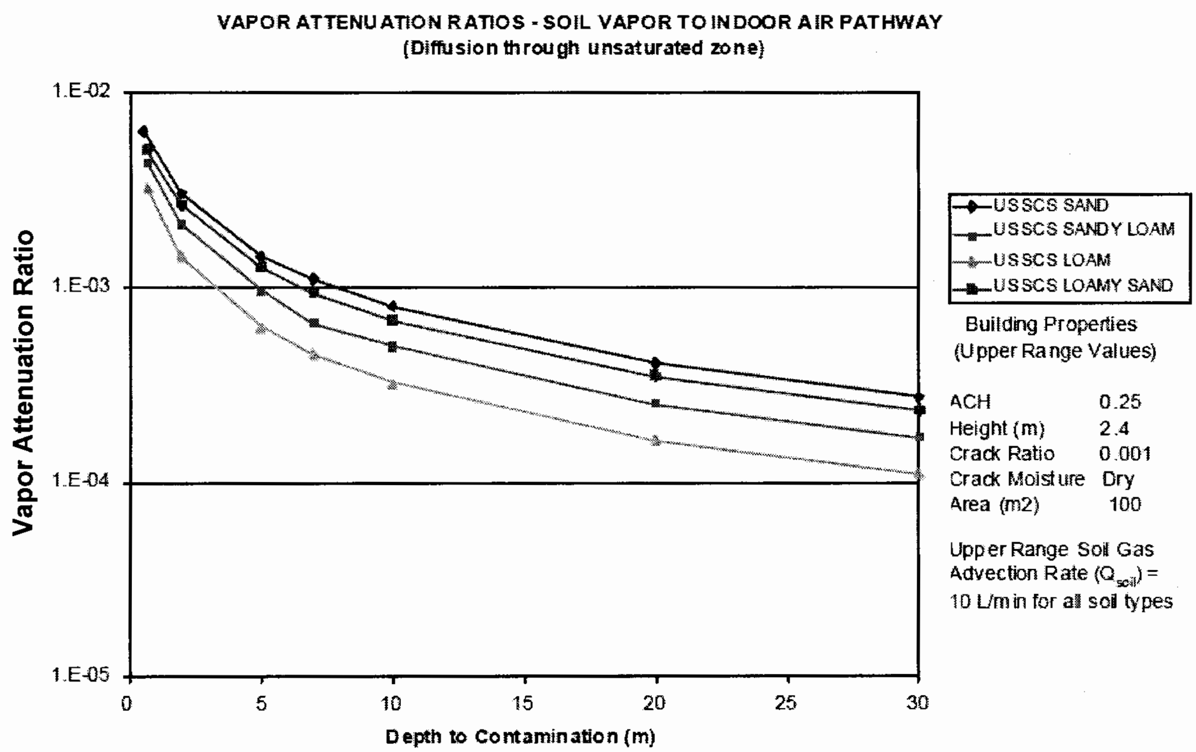


FIGURE 1

Graph 1a. For use with soil gas monitoring data.
(future edits to add: units of feet, ½ order-of-magnitude lines, and clarify y-axis is "Vapor Attenuation Ratio")

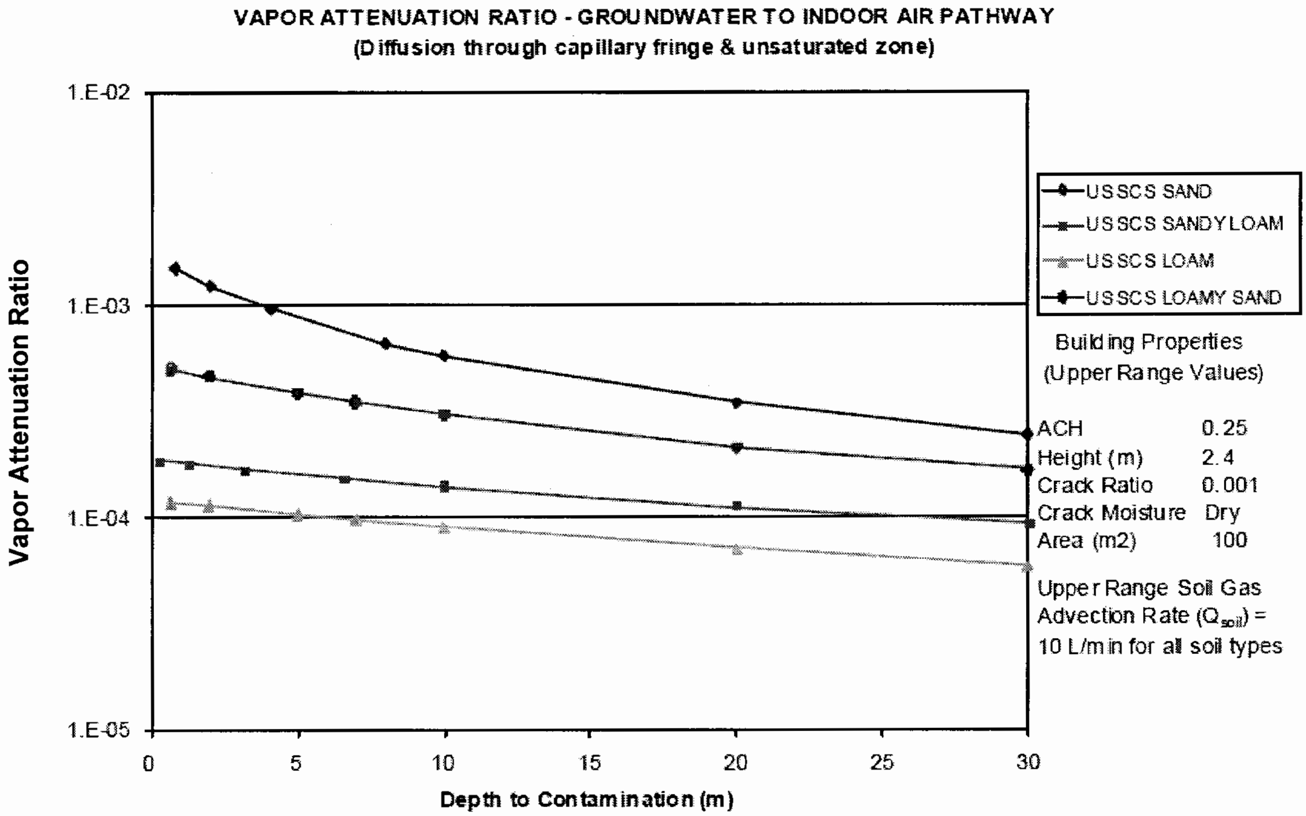


FIGURE 2

Graph 1b. For use with groundwater monitoring data.
(future edits to add: units of feet, ½ order-of-magnitude lines, and clarify y-axis is "Vapor Attenuation Ratio")

Rationale for Selecting Site-Specific Attenuation Factor and Reference(s):

Site-Specific Assessment – Question 6

Q6: Do measured or reasonably estimated soil gas or ground water concentrations exceed media-specific criteria developed specifically for this site?

_______ If YES - check here and implement exposure controls (avoidance or mechanical systems with appropriate monitoring to demonstrate their effectiveness) to prevent possible human exposures to subsurface vapors migrating into indoor air. Prepare a performance monitoring plan and proceed to Question 7;

_______ If NO – check here and provide documentation of Site-Specific Assessment for regulatory review.

_______ If sufficient data are not available - check here and skip to Pathway-Specific EI Summary Page and enter "IN" (more information needed) status code.

Criteria:

The Site-Specific Pathway Assessment is intended to be used where site-specific conditions warrant further consideration prior to concluding either that the pathway is incomplete, or that some form of exposure control is required. The assessment could be as simple as using the same equations employed to develop the Secondary Screening criteria but with revised inputs that are defended with site-specific data. It could also be as complex as a comprehensive mapping of subsurface vapor distributions and measurement of subsurface material properties affecting gas flow and transport, combined with the development of a site-specific vapor transport model. The data needs are greater here than in the Primary and Secondary Screening; however, the necessary data might already be available from previous site characterization work. A conceptual model of the site and subsurface vapor transport and vapor intrusion mechanisms will be needed to defend the Site-Specific Pathway Assessment. Model inputs and assumptions that are different than the generic assumptions in Questions 4 and 5 criteria (and others to be added to the appendices) must be supported with site-specific data.

The site-specific conceptual model should be developed in the source-pathway-receptor framework, and it should identify how the site-specific conceptual model is similar to, and different from, the generic conceptual model used in developing Table 3. Key components of the conceptual model may need to be justified with site-specific data, including, but not limited to the source (chemical constituents, concentrations, mass, phase distribution, depth, and aerial extent), pathway (soil texture, moisture, and layering) and receptor (building design, construction, and ventilation). The indoor air concentrations may be simulated with a mathematical model, which the user must be prepared to document and defend as appropriate for the site-specific conceptual model. The user must also defend model inputs (different than those (to be added to) the appendices) by validated site-specific data. The discussion above in Appendix A concerning data sufficiency is also applicable here. Indoor air quality sampling and analysis is neither required, nor precluded; however, if indirect data (e.g. soil gas data) are to be used exclusive of indoor air quality data, the vapor attenuation factor must be assigned either using site-specific data (e.g. the building ventilation rate, pressure differentials, soil gas permeability), or using conservative assumptions. If the pathway is not judged to be incomplete during the Primary, Secondary, or Site-Specific Screening, it is considered to be complete, unless some action is taken. Possible actions include:

- engineered containment systems (subslab de-pressurization, soil vacuum extraction, vapor barriers)
- ventilation systems (building pressurization, indoor air purifiers)
- avoidance (temporary or permanent receptor relocation) or
- removal actions to reduce the mass and concentrations of subsurface chemicals to acceptable levels
- (i.e., remediation efforts).

Rationale and Reference(s):

Post-Assessment Monitoring – Question 7

Q7: Will temporal monitoring data or performance monitoring data (for a mechanical exposure control system) be collected to assess whether the pathway remains incomplete?

______ If YES - check here and provide a brief summary of the monitoring requirements, or reference monitoring work plan.

______ If NO – check here and provide justification.

Criteria:

Performance Monitoring is necessary to ensure that the pathway remains incomplete for sites relying on exposure control systems. **Pathway Monitoring** is recommended for sites where the measured or reasonably estimated media concentrations are at, or marginally less than the target media concentrations for that site, or when temporal trends cannot be reasonably predicted with existing data. This could involve repeated sampling of groundwater, soil gas, or indoor air on some appropriate frequency. The need for pathway monitoring is decided by the lead regulatory authority; however, one should consider the derivation of the target media concentrations and differences between those and measured or reasonably estimated values when determining monitoring requirements. Presumably, monitoring is less important in cases where measured or reasonably estimated media concentrations are an order of magnitude less than the more conservative media criteria (Table 2), and monitoring is more important when measured or reasonably estimated media concentrations are only marginally less than criteria selected at Question 5 (Table 3) or Question 6. As additional data becomes available, it should be compared with previous data as well as the target media-specific concentrations. If exceedances occur, or are projected to occur, appropriate actions (usually engineering controls) should be taken, or continued. If monitoring demonstrates that the pathway is incomplete and will remain so under current site conditions, then other actions are not necessary.

Rationale and Reference(s):

EVALUATING THE VAPOR INTRUSION TO INDOOR AIR PATHWAY

Pathway-Specific EI Summary Page

Facility Name: **Lyondell Chemical Company**

Facility Address: **3801 West Chester Pike, Newtown Square, Pennsylvania**

Facility EPA ID #: **PAD046538211**

Below, check the appropriate status codes for the Subsurface Vapor to Indoor Air Pathway evaluation on the EI determination and attach appropriate supporting documentation as well as a map of the facility.

Is there a Complete Pathway for subsurface vapor intrusion to indoor air?

__X__ NO – the "Subsurface Vapor Intrusion to Indoor Air Pathway" has been verified to be incomplete, based on review of the information contained in this EI Determination of the **Lyondell Chemical Company** facility, EPA ID # **PAD046538211**, based on performance monitoring evaluations for engineered exposure controls. This determination will be re-evaluated when the Agency/State becomes aware of any significant changes at the facility.

____ YE – Yes, The "Subsurface Vapor to Indoor Air Pathway" is Complete.

____ IN – More information is needed to make a determination.

Locations where References may be found.

USEPA Region III Waste and Chemical Mgmt. Division 1650 Arch Street Philadelphia, PA 19103	PADEP South East Regional Office 2 E. Main Street Norristown, PA 19401

Contact telephone and e-mail numbers:

(name) ______________________

(phone #) ______________________

(e-mail) ______________________

This document is dedicated to the late Craig Mann, who was a member of the authoring committee, a prominent researcher in the field and programmer of the widely-used spreadsheet version of the Johnson and Ettinger (1991) model available at www.epa.gov/superfund/programs/risk/airmodel/johnson_ettinger.htm. He was a friend and inspiration to us all.

FINAL NOTE: THE HUMAN EXPOSURES EI IS A QUALITATIVE SCREENING OF EXPOSURES AND THE DETERMINATIONS WITHIN THIS DOCUMENT SHOULD NOT BE USED AS THE SOLE BASIS FOR RESTRICTING THE SCOPE OF MORE DETAILED (E.G., SITE-SPECIFIC) ASSESSMENTS OF RISK.

RCRA Land Revitalization Indicators
Status of Use &Type of Use

EPA	United States ENVIRONMENTAL PROTECTION AGENCY Region III, Philadelphia, PA		
1. Date: **April 10, 2013**			
2. Facility Name **Lyondell Chemical Company**		**3. EPA ID** **PAD046538211**	
4. Your Name **Susan R. Frund**		**5. Organization** **Michael Baker Jr., Inc.**	
6. Total Acres **312 acres**			
Continued Use: **Total acres_312____**	**Reused:** **Total acres_______**	**Planned Reuse:** **Total acres________**	**Unused:** **Total acres________**
Types of Use ( ) Agricultural ( ) Commercial ( ) Ecological (**X**) Industrial ( ) Military ( ) Other Federal ( ) Public Services ( ) Recreational ( ) Residential ( ) Mixed Use	**Types of Use** ( ) Agricultural ( ) Commercial ( ) Ecological ( ) Industrial ( ) Military ( ) Other Federal ( ) Public Services ( ) Recreational ( ) Residential ( ) Mixed Use	**Types of Use** ( ) Agricultural ( ) Commercial ( ) Ecological ( ) Industrial ( ) Military ( ) Other Federal ( ) Public Services ( ) Recreational ( ) Residential ( ) Mixed Use	

Unit Conversions: 1 square foot = 0.000023 acre; 1 square meter = 0.0002471 acre

Current Land Use

Continued Use - A site or portion of a site which is currently being used in the same general manner as it was when the site became contaminated. For example, continued use would be an appropriate description for a property where industrial operations resulted in the contamination and the property is still used as an operating industrial facility. The RCRA Program will count all acres of an active RCRA industrial facility as Continued Use, except for parcels specifically designated as Reused or Planned Reuse.

Reused - A site or portion of a site where a new use, or uses, is occurring such that there has been a change in the type of use (e.g. industrial to commercial) or the property was vacant and now supports a specific use. This means that the developed site, or portion of the site, is "open" or actually being used by customers, visitors, employees, residents, etc.

Planned Reuse - A site or portion of a site where a plan for new use is in place. This could include conceptual plans, a contract with a developer, secured financing, approval by the local government, or the initiation of site redevelopment.

Unused - A site or portion of a site that is currently vacant or not being used in any identifiable manner. This could be because site investigation and cleanup are on-going, operations ceased or owner is in bankruptcy, or cleanup is complete but the site remains vacant.

Types of Use

Commercial Use – Commercial use refers to use for retail shops, grocery stories, offices, restaurants and other businesses.

Public Service Use – Public service use refers use by a local or state government agency or a non-profit group to serve citizens' needs. This can include transportation services such as rail lines and bus depots, libraries and schools, government offices, public infrastructure such as roads, bridges, utilities or other services for the general public.

Agricultural Use – Agricultural uses refers to use for agricultural purposes, such as farmland for growing crops and pasture for livestock. It also can encompass other activities, such as orchards, agricultural research and development, and irrigating existing farmland.

Recreational Use – Recreational use refers to use for recreational activities, such as sports facilities, golf courses, ball fields, open space for hiking and picnicking, and other opportunities for indoor or outdoor leisure activities.

Ecological Use – Ecological use refers to areas where proactive measures, including a conservation easement, have been implemented to create, restore, protect or enhance a habitat for terrestrial and/or aquatic plants and animals, such as wildlife sanctuaries, nature preserves, meadows, and wetlands.

Industrial Use – Industrial use refers to traditional light and heavy industrial uses, such as processing and manufacturing products from raw materials, as well as fabrication, assembly, treatment, and packaging of finished products. Examples of industrial uses include factories, power plants, warehouses, waste disposal sites, landfill operations, and salvage yards.

Military Use – Military use refers to use for training, operations, research and development, weapons testing, range activities, logistical support, and/or provision of services to support military or national security purposes.

Other Federal Use – Other federal use refers to use to support the Federal government in federal agency operations, training, research, and/or provision of services for purposes other than national security or military.

Mixed Use – Mixed use refers to areas at which uses cannot be differentiated on the basis of acres. For example, a condominium with retail shops on the ground floor and residential use on the upper floors would fall into this category.

Residential Use – Residential use refers to use for residential purposes, including single-family homes, town homes, apartment complexes and condominiums, and child/elder care facilities.